# The Builder.

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### *Recent Work at Orvieto Cathedral.*

THE building of Orvieto Cathedral, the design of which has usually been assigned to Lorenzo Maïtani of Siena, was an event which excited immense enthusiasm among the inhabitants, as we may judge not only from the records of the time, but from the mere fact that only about seven or eight years after the laying of the foundation stone, a very short time for cathedral building in those days, the building was so far advanced that mass was said in it at a provisionally erected altar, in 1298. The peculiar arrangement of the plan perhaps bears testimony also to this eager determination to have a cathedral as quickly as possible, after the ambitious idea first dawned on the Orvietans. The cathedral was thrust in as space could be found for it at the moment, and squeezed in to fit the lines of the available site; the two transepts, one narrower than the other, taking an oblique line, the left hand transept (looking from the nave) sloping off at an angle towards the choir end of the building, and the crossing arch being carried obliquely across the end of the nave. To approach this difficulty conveniently the left hand columns of the nave arcade, in the last two or three bays, are slightly advanced so as to lead up gradually to the skew position of the crossway arch. The eagerness of the Orvietans to beautify their cathedral was shown a century and a half later, when, hearing that a certain gifted painter, known as Fra Angelico, was for three months at liberty from his work elsewhere, they promptly secured him for that period and got him to paint the ceiling of one transept with as much as could be done in the time, figures of Christ and the Prophets, leaving the rest of the work until a greater painter, Luca Signorelli, half-a-century afterwards, made the place famous for ever in the annals of painting by his pictures of the Resurrection and the Judgment. A less well-directed enthusiasm in the sixteenth century, still in the desire for what at the moment was supposed to be artistic perfection, would have led to the recasing of the whole building with a Renaissance overlay, but fortunately this was not carried far enough to obliterate all the original work.

The succession of five small side chapels in the shape of apses along either wall of the nave is another peculiarity of the plan, especially in the way these are arranged, not centrally with each of the six bays, but so that one jamb of each apse is opposite a pier of the arcade, and the other opposite the centre of the bay. It is difficult to understand the reason for this very unarchitectural arrangement.

The building is an exceptionally pronounced example of the very Italian tendency to concentrate the chief exterior architectural display on the entrance façade of the church. At Orvieto there is really hardly any architectural treatment worth mentioning except on this façade. The rest (and the same may be said of the interior of the nave walls) is a dreary expanse of masonry in stripes of alternating light and dark colours, with windows stuck in at intervals. The façade is a *tour-de-force* of decorative treatment of a rich and most minute kind; one may notice especially the minute geometrical inlay within the hollows of the twisted columns of the doorways. But in general the effect is not of the highest stamp architecturally. It has too much the look of furniture, of a cabinet front on a great scale, the work having a framed and panelled appearance at variance with the idea of building work in the proper sense of the word. The arcade carried across half-way up the front, with its deeply recessed arches, is the best architectural feature. The rose window tracery is not well designed, the outer portion of the tracery looking as if the cusped divisions sprang out of the jamb inwards, instead of radiating outwards towards it. There is a curious eccentricity, too, in the manner in which the arches of the three great doorways are sprung, not from the large and elaborate cornice which is the crowning of the piers, and which seems to have been intended to be the impost line, but from a subsidiary small string two or three feet above it. The device looks as if, after the main string had been worked and set, it was found the arches would not rise high enough, and the additional string course was inserted to avoid to some extent the appearance of what is really a stilt of the arches. Probably, however, it was deliberately intended, as there is a nearly similar treatment at Siena. At all events, the architectural effect is not good. The best point in the whole façade is the sculpture decoration of the great pilaster-like spaces between the doorways; not only for the interest of the work itself, but as an example of the proper placing of bas-relief sculpture of this kind, where it can be seen, instead of placing it in some position aloft where half its detail is lost.

The cathedral seems to have been in a sadly neglected state in the early part of this century, for when MM. Benois, Resanoff, and Krakau, the three Russian architects who have produced the best illustrative work on the building, first visited it in 1842, they found the interior covered with so thick a layer of dust that the frescoes and decorations could not be seen, and obtained official permission to wash it down with clean water. It would be well if all "restoration" operations were of as harmless and beneficial a nature as this.

Recently a good deal of repairing work has been done at the cathedral, especially in regard to the timber roof of the nave, which was found to be in such a decayed condition that its renewal, piece by piece, was considered a necessity.

Before further describing what has been done, we may mention that the recent examination of the building and its records, in preparation for this work, has led to a reconsideration of the theory as to who was its original designer; and that Signor Zampi, the architect in charge of the repairs, has seen reason to conclude that Arnolfo di Cambio was the first architect of the cathedral, usually associated with the name of Lorenzo Maïtani only. Part of the evidence for this consists of two ancient drawings on vellum, preserved in the Museo dell'Opera, the older of which is attributed to Arnolfo di Cambio, and the design shown in the second and later one seems to be worked out from this. There are other inci-

dents in the building itself, vestiges of the commencement of an earlier building which point in the same direction, and it is known that Arnolfo di Cambio, who took a prominent part in the first work of the Florence Cathedral, was well known in Orvieto, and was actually there at the time when the scheme for the cathedral was first discussed in the town.

The cathedral, internally as well as externally, was practically completed by the commencement of the sixteenth century. The apse was decorated with fresco paintings depicting the life of the Virgin; the central window and those at the sides of the apse were adorned with stained glass, and the whole choir with fresco paintings; and in every part of the work the taste of the fifteenth century had, so to speak, left its impress on the Gothic character of the church.

When in 1527 (after the pillage of Rome) Clement VII. took refuge at Orvieto, some modifications were projected in the internal decorations; and later on, in 1537, when the Rites of Rome had become general in the churches of the vicinity of Rome, Paolo III. ordered the choir to be transferred to the apse and the crypt to be closed.

As a consequence of these innovations suggested by the introduction of the new rite, an architect of the day, Ippolito Scalza, conceived the idea, as before mentioned, of transforming the church entirely into a building in the Renaissance style. Scalza, born in 1532, at Orvieto, had studied under Michelangelo; he was eminent as a sculptor and an architect, and became director of the works of the cathedral. He developed a large scheme for the redecoration of the church on classical models; and even commenced its execution. From his existing sketches we find that it was his intention to introduce Ionic columns into the piers of the side aisles, to turn the Gothic arched windows into rectangular openings, and to decorate the chapels with marble; but on account of the cost stucco was used instead. Thus the chapels were adorned with stucco work and painted decorations from the drawings of Scalza and of Raffaello de Montelupo. The remaining part of the project was not carried out, though there are still a great many details in the cathedral which are due to Scalza, such as the splendid organ-case and various statues; and there is in the Museo dell'Opera, together with the plan for the transformation of the cathedral, a design of a campanile by Scalza himself, which is not without a certain grandeur of style.

The restoration committee went into their work with the view of remodelling the building in conformity with the older plan and destroying the modern modifications. This policy was inaugurated by Sigr. Leander Mazzocchi, secretary of the works; the treasurers, Giacomo Bracci and Sante Felici pursued it with renewed vigour, and the final impulse was given by the present chairman of the administration, Carlo Franci, who, from the year 1880 down to the present day, has laboured in conjunction with the architect, Zampi, and the historian, Fumi, in restoring to the monument its ancient design. Thus the walls have all been divested of Scalza's stucco decorations. The painting of one chapel has been executed as a trial for the decorations of the rest (it must be confessed the result is not altogether satisfactory); the windows have received their stained glass, while the fantastically stained talc plates (a feature of the Cathedral of Orvieto) have been reinstated and the roof has been reconstructed.

The chief interest in the recent work consists in the treatment of the roof. This roof is supposed to date from 1309, though at an early period of its existence it evidently was not in a very solid condition, as, from a document of the year 1416, we learn that an artisan, named Marretta, had been entrusted with the reconstruction of it. At the present time the old timbering was found completely out of order when the work of restoration was started in 1881. In 1867, by the care of the "Ufficio del Genio Civile" of Perugia, preliminary studies had been commenced which were afterwards used as a basis for compiling the general scheme of repair. Unexpected difficulties were met with in the course of the realisation of this work, to such an extent as to bring about the cancelling of the Government contract, but these were eventually got over and the work of demolition and rebuilding was allowed to proceed with regularity up to October, 1886, when the woodwork was finished and followed by the decoration, which was also brought to an end shortly afterwards, and the roof of the cathedral now professes to be a representation of the original work as it was before its decay.

The roof-principals were renewed one by one, and Signor Zampi considers that he has succeeded in reproducing everything with the utmost accuracy. The only one occasion when he departed from the original work was in lining with copper the upper surface of the cornices, and replacing the terra-cotta tubes between the small columns by copper tubing to carry off the water from the walls.

The work has only cost the moderate sum of 200,000 francs (8,000*l.*). Many more details are still awaiting completion, and will in time be attended to; though none of such importance as the repair of the roof, which was a matter of absolute necessity, and has been carried out with commendable care and energy. Whether this replacing of a decaying timber roof by a new one giving an exact reproduction of it is so satisfactory a solution of the difficulty as Italian critics seem to think, may be a question; but it seems pretty clear that the roof-timbers had to be renewed to put the building in a sound condition, and no doubt Italian opinion at the present day would be in favour of imitating the old design, and even regard the imitation as of equal interest with the original. In England we might take a different view.

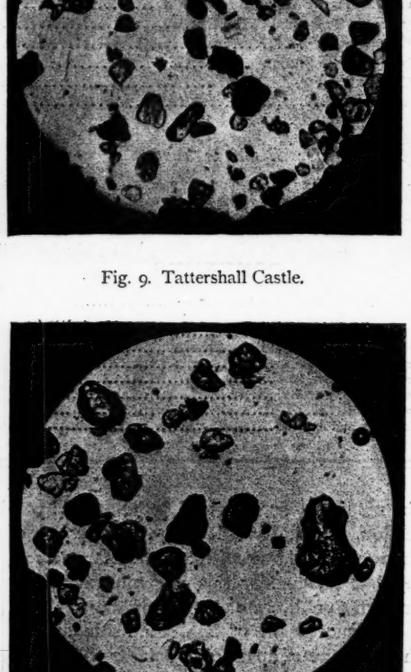

Fig. 9. Tattershall Castle.

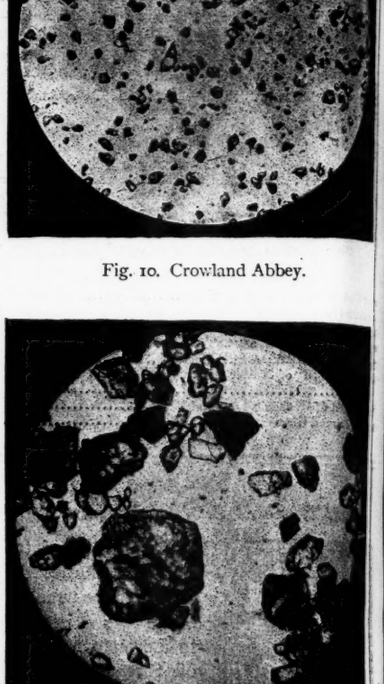

Fig. 10. Crowland Abbey.

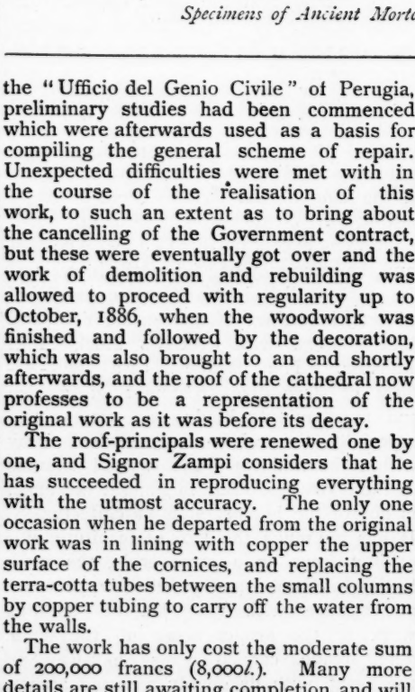

Fig. 11. Fountains Abbey.

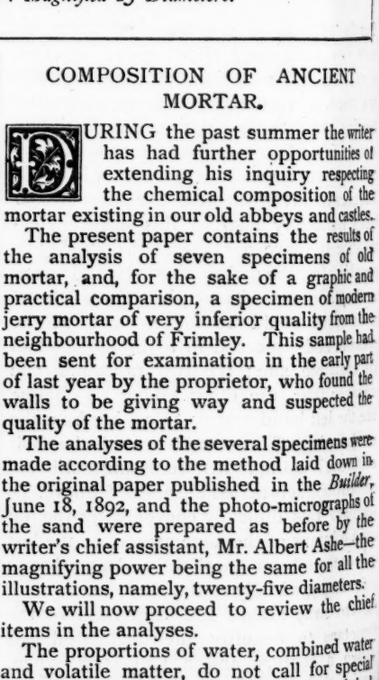

Fig. 12. Bolton Abbey.

*Specimens of Ancient Mortar: Magnified 25 Diameters.*

## COMPOSITION OF ANCIENT MORTAR.

DURING the past summer the writer has had further opportunities of extending his inquiry respecting the chemical composition of the mortar existing in our old abbeys and castles.

The present paper contains the results of the analysis of seven specimens of old mortar, and, for the sake of a graphic and practical comparison, a specimen of modern jerry mortar of very inferior quality from the neighbourhood of Frimley. This sample had been sent for examination in the early part of last year by the proprietor, who found the walls to be giving way and suspected the quality of the mortar.

The analyses of the several specimens were made according to the method laid down in the original paper published in the *Builder*, June 18, 1892, and the photo-micrographs of the sand were prepared as before by the writer's chief assistant, Mr. Albert Ashe—the magnifying power being the same for all the illustrations, namely, twenty-five diameters.

We will now proceed to review the chief items in the analyses.

The proportions of water, combined water and volatile matter, do not call for special remark. In the Frimley analysis the original mortar, which contained 9 per cent. of water, lost at 212° F., had to be dried before being reduced to a powder sufficiently fine for analysis.

Passing on to the consideration of the figures for lime, we are at once struck with the great variation; the mortar from Crowland Abbey, in Lincolnshire, contains the highest percentage, 41·50, and the specimen from Fountains Abbey the lowest, 15·79, but the latter still contains in round numbers twice as much as was found in the wretched jerry mortar, which only shows 8·31 per cent. of lime in its present dried condition. It is, therefore, no wonder that the quality of the

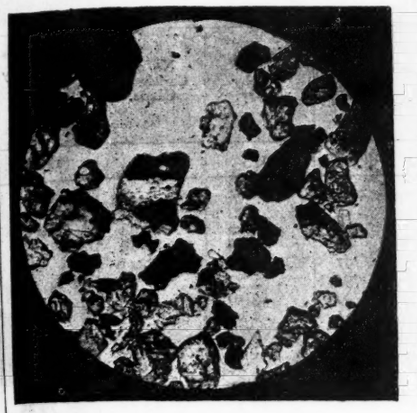

Fig. 13. Barden Tower.

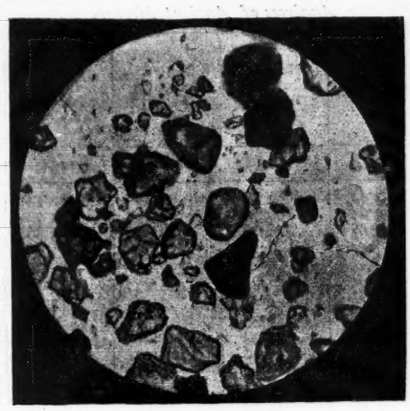

Fig. 14. Whitby Abbey.

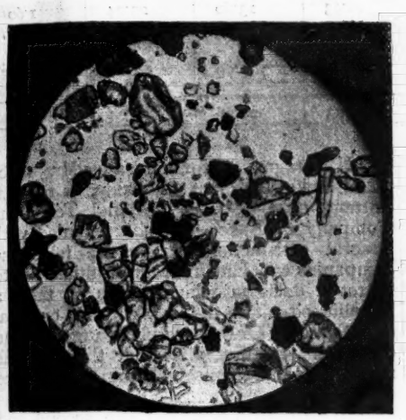

Fig. 15. Carisbrook Castle.

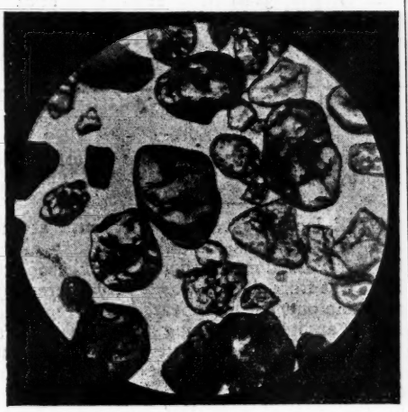

Fig. 16. Modern Jerry Mortar, Frimley.

*Specimens of Ancient Mortar: Magnified 25 Diameters.*

latter was condemned, and the walls had to be rebuilt.

The average quantity of lime in the seven specimens is 25·95 per cent., or three times that found in the Frimley mortar. Next as regards the quantity of magnesia, we notice that Fountains contains a remarkably high percentage, 5·66, then comes Whitby with 1·15, while the remaining specimens contain practically only minute quantities.

In the original paper (see *Builder* for June 18, 1892) the specimen which contained the most magnesia was that from the leaning tower of Caerphilly Castle, in Glamorganshire, the figures being 1·87, while the mortar was regarded as of undoubted durability and tenacity.

It may be here remarked that it is a curious coincidence that of the seven specimens, the mortar from Fountains and Whitby, for reasons presently to be put forward, is regarded by the writer as being of the best quality. In reference to the former of these it may be mentioned that the relative proportions of lime and magnesia suggest that the mortar used in building Fountains Abbey was made from magnesian limestone (Dolomite). The wonderful hardness and lasting character of this mortar are practically shown by comparing the perfect condition of the pointing with the decayed state of the porous stone, especially on the south side of the Abbey where the weathering influences of alternate rain and sun, heat and cold, would be specially experienced. The proportions of potash and soda do not require any special remark, as the quantities are but small in all cases.

Nor do the figures for oxide of iron and alumina require comment, except to point out that Whitby contains the most oxide of iron, 3·50, and alumina 1·85, while Fountains contains the least oxide of iron 1·01, and alumina 2·54, the proportions of iron to alumina being reversed in these two specimens in a somewhat marked manner.

Sulphuric acid is small in all the specimens except in Tattershall, where the figures rise to 1·15.

Carbonic acid varies considerably and as the proportions rise and fall according to the proportions of lime it is quite reasonable to conclude that most of the lime now exists in the state of carbonate of lime.

Chlorine, as we should expect, occurs in small quantity, Bolton Abbey having the least, 0·05, and Carisbrook, in the Isle of Wight, the most, ·38.

We now come to the figures for gelatinous silica to which the writer attaches great importance when determining the probable induration and tenacity of a mortar. In this respect Whitby stands highest with 8·20, while Fountains 5·75, Bolton 5·65, and Crowland 5·01 come next, then Barden Tower 4·80, Carisbrook Castle 4·35, and last, Tattershall 3·05, which is the only one that contains less than found in the bad Frimley mortar, which has 3·95.

This gelatinous or hydrated silica is the active constituent in Portland cement, and just in proportion as limestones furnish a lime rich in this constituent so are they valuable for making mortar that sets quickly and ultimately becomes specially hard.

Thus, Dorking grey lime when freshly burned contains 9 per cent. of gelatinous silica, while good Aberthaw blue lias is still richer, containing as much as 15 per cent., and as a consequence closely approaches in its famous building properties the best Portland cement in which the percentage of gelatinous silica rises to 20 or 21.

Indeed when good Aberthaw lime can be obtained at a low rate of carriage it is probably more economical than cement.

Let us now examine the figures for actual sand, the last item in the analytical results, and in doing so the illustrations may be usefully at the same time compared, though a few words respecting these will be specially added, as regards the variations in size, angularity, and general character.

It will be at once noticed that Bolton Abbey contains the most sand, 47·95, though Fountains contains almost as much, 47·15. Whitby, too, for all practical purposes of comparison, is very similar in this respect, the figures being 46·55.

Tattershall Castle follows closely with 44·10, accompanied with Carisbrook Castle, having 43·72.

Then there is a falling off of nearly 10 per cent., Barden Tower having only 32·95, while a still more marked falling off occurs in Crowland Abbey, which contains the lowest quantity of sand, and the illustrations show us that it is also the smallest in size, and in all probability was associated with the natural limestone from which the lime was made.

If we include the figures for magnesia with those for lime and then calculate their combined relation to sand in these analyses, we have the following:—

| | | | |
|---|---|---|---|
| Crowland contains | 1 part of lime | to | 0·34 sand. |
| Barden | ,, | ,, | 1·08 ,, |
| Carisbrook | ,, | ,, | 1·70 ,, |
| Tattershall | ,, | ,, | 1·75 ,, |
| Bolton | ,, | ,, | 1·98 ,, |
| Whitby | ,, | ,, | 2·16 ,, |
| Fountains | ,, | ,, | 2·19 ,, |
| Frimley | ,, | ,, | 8·70 ,, |

It will be observed that in none of the old mortars does the proportion of sand rise in round numbers above 2 to 1; whereas in the wretched jerry mortar the proportion rises to nearly 9 to 1 of lime.

As regards the illustrations, taking them in the order in which they are placed, we may remark that Tattershall is clearly a mixture of two different kinds of sand, the greater portion consisting of small, sharp grains of good quality, and the remainder being somewhat rounded and water worn; on the whole a fair specimen.

Crowland is an exceedingly fine, sharp, uniform sand, very different from any of the others examined.

Fountains, Bolton, and Barden are so similar in general size and character that they may be considered together, representing a large but sharp sand with rough edges, and therefore of good quality.

Of the three, Fountains, being smaller, is to be preferred for building purposes.

Whitby is a mixture of large, rounded grains, interspersed with some small sharp ones; on the whole not a good specimen, so that any superior goodness in the mortar must be regarded as due to the lime employed rather than to the sand.

Carisbrook gives us an almost perfect example of what a good building sand should be, varying greatly in size and form, the edges being very sharp and the general appearance being that of broken quartz.

Frimley, on the other hand, gives us an instance of a sand that should be most carefully avoided by builders, for it is coarse, water-worn, and destitute of that angularity so essential in producing a durable mortar,—for there is an entire absence of those indentations of the surface which always afford such a good grip to the lime. Having now reviewed the characteristics of these specimens, the question arises, What are the general conclusions to be drawn from the analyses?

1. That the proportions of lime have been found to vary considerably, and that a high percentage is not necessarily indicative of superior quality.

2. That the proportions of sand have also been found to vary considerably, and that, on the whole, the specimens which contained the most were generally of superior quality, *but that in no case did the proportion of sand to lime exceed in round numbers that of* 2 *to* 1, which is very much less than is usually found in modern mortar, whilst in jerry mortar it is often as much as 9 to 1.

3. That the proportion of gelatinous or

*Analyses of Ancient Mortar.*

| | No. 9. Tattershall Castle. | No. 10. Crowland Abbey. | No. 11. Fountains Abbey. | No. 12. Bolton Abbey. | No. 13. Barden Tower. | No. 14. Whitby Abbey. | No. 15. Carisbrook Castle. | No. 16. Modern Jerry Mortar, Frimley, Hants. |
|---|---|---|---|---|---|---|---|---|
| Probable date of erection, about A.D. | 1433 | 1113 | 1132 | 1154 | 1485 | 1175 | 1467 | 1891 |
| Water (lost at 212 deg. F.) | 1·42 | 1·26 | 2·18 | ·74 | 1·84 | 2·04 | 1·55 | ·40 |
| Combined water and volatile matter | 3·64 | 2·76 | 3·56 | 2·02 | 3·89 | 2·93 | 3·41 | 1·36 |
| *Lime | 24·83 | 41·50 | 15·79 | 23·86 | 29·73 | 20·38 | 25·44 | 8·31 |
| Magnesia | ·27 | ·34 | 5·66 | ·25 | ·64 | 1·15 | ·18 | ·79 |
| Potash | ·24 | ·41 | ·23 | ·14 | ·97 | ·23 | ·41 | ·21 |
| Soda | ·14 | ·42 | ·17 | ·15 | ·53 | ·33 | ·29 | ·24 |
| Oxide of iron | 2·50 | 2·65 | 1·01 | 1·80 | 1·29 | 3·50 | 1·32 | 3·08 |
| Alumina | 1·25 | ·55 | 2.54 | ·25 | ·51 | 1·85 | ·33 | ·67 |
| Sulphuric acid | 1·15 | ·34 | ·60 | ·34 | ·80 | ·65 | ·36 | ·36 |
| Carbonic acid | 17·26 | 30·46 | 15·10 | 16·80 | 21·86 | 11·95 | 18·26 | 1·26 |
| Chlorine | ·15 | ·06 | ·26 | ·05 | ·19 | ·24 | ·38 | ·12 |
| Gelatinous Silica, soluble in alkali | 3·95 | 5·01 | 5·75 | 5.65 | 4·80 | 8·20 | 4·35 | 3·95 |
| Insoluble matters (sand) | 44·10 | 14·24 | 47-15 | 47·95 | 32·95 | 46·55 | 43·72 | 79·25 |
| | 100·00 | 100·00 | 100·00 | 100·00 | 100,00 | 100·00 | 100·00 | 100·00 |
| *Lime present as carbonate | 21·59 | 38·29 | 11·30 | 21·04 | 26·93 | 13·60 | 23·24 | 1·60 |
| *Lime present as caustic | ·22 | ·22 | ·55 | ·33 | ·22 | ·55 | ·84 | Not done, |
| *Lime present as sulphate | ·80 | ·23 | ·42 | ·23 | ·56 | ·24 | ·25 | ·25 |
| Lime present as silicate and otherwise combined | 2·22 | 2·76 | 3·52 | 2·26 | 2·02 | 5·99 | 1·11 | Not calculated. |
| | 24·83 | 41·50 | 15·79 | 23·86 | 29·73 | 20·38 | 25·44 | |

hydrated silica found in a mortar is a reliable indication of its durability and tenacity, and that the higher the percentage of this constituent, the more closely will such mortar approach the character of cement.

4. That in the examination of local limestones as to their suitability for building purposes, the relative richness in this gelatinous silica should be specially reported upon.

J. H.

## NOTES.

THE report of the Chief Officer of the Metropolitan Fire Brigade on the London fires of last year treats, as usual, solely of the large amount of work done by this inadequately-manned force. The number of actual fires which had to be attended was 3,146, and the number of chimney fires about 1,500, both large figures, especially if we remember the number of minor fires to which the Brigade is not called. Of the fires attended, the report classifies 177 as serious, a small percentage if we had not misgivings as to the very unsatisfactory system on which this classification is based. There were several very serious fires in January and November which called for great exertions on the part of the Brigade—to such an extent, in fact, that there can sometimes only have been about 100 men available for other fire service in the metropolis at hours and in seasons, as it happened, which are known to be the most dangerous. This is, however, by no means surprising, as Chief Officer Simonds has only some 700 firemen at his disposal for the protection of a city which, according to Captain Shaw, should have had 930 in 1872. In 1892 no less than 145 lives were saved out of fires, forty of which were, however, afterwards lost through injuries received. Twenty-four lives were actually lost in fires, and three firemen were killed, which makes sixty-seven, the total number of fatal casualties. The number of accidents due to fires is not reported, excepting as regards members of the Brigade, among whom there were ninety-two cases of injuries. Two cases of incendiarism have been proved, about 1,900 fires are reported as due to ordinary carelessness, and about 250 to structural defects. That nearly one-third of the London fires should be simply classified as due to "unknown" causes does not speak well for the amount of care and time given to research. That the Brigade should be molested with 497 malicious calls is a disgrace to the metropolis. Until the option of a fine for such rowdyism be abolished, the nuisance, with the danger thereby incurred, will, however, probably continue. The alterations in the getting-up of the report are an improvement.

THE lecture given by Dr. Poore at the Parkes Museum on Wednesday evening, on "London Fogs, and the Lessons to be learnt from them," was a very interesting and able one, but he appeared to be regarded by his auditors as taking too pessimistic a view of the subject, and to be somewhat visionary in some of his proposals. He clearly showed that there was a great increase in the rate of mortality during the long-continued prevalence of fogs, and he also demonstrated that the really dangerous and fatal element in a London fog is the dirt, in the shape of carbon and other mineral matter, together with all the unwholesome exhalations of a crowded city which a London fog of many hours' duration holds in its embrace. He finds that the worst fogs of recent years have been most fatal in the central districts of London, and his argument is that it is precisely in those districts where the population is most crowded where, consequently, the air most quickly becomes polluted when stagnant, as is the case during the prevalence of fog. He likened the condition of the inhabitants of the central districts of London under such circumstances to that of gold fish in a globe if the water were left unchanged. He strongly condemned the growing practice of building high dwellings in towns on the flat system. Back-to-back buildings, he said, were not allowed to be built in London, but no objection was raised to the piling of one house upon another. It might have been pointed out in the course of the discussion that followed that there was no analogy (in the matter of ventilation) between back-to-back buildings and dwellings in flats: in the former there is no means of getting a strong current of air through the buildings from front to back; in all the dwellings in flats which we have ever seen there have been ample opportunities for through ventilation. Dr. Poore spoke of the increased use of gaseous fuel as likely to diminish the impurities of the air, and one speaker advocated the use of anthracite coal, but Sir Douglas Galton, who was in the chair, said he had never seen his way to advocate the use of anthracite, for unless the combustion was perfect and the draught good, there was the serious danger of getting a back draught of carbonic oxide into the room. Dr. Poore, in the course of his paper, expressed the view that fogs were on the increase. Mr. G. J. Symons, the well-known meteoroloist, expressed his opinion that that was not the case, but he admitted that the fogs of recent years were much dirtier than those of thirty or forty years ago.

THE judgment pronounced by Mr. Justice Kekewich, last Saturday, in the important case of The National Telephone Company *v.* Baker, will be regarded with general satisfaction. Even the telephone companies can have no reason ultimately to regret a decision which forces on them a metallic circuit as the only cure for external disturbance. Of the two pleas urged by the defendant, the first, viz.: that the plaintiffs might so defend themselves from the nuisance caused by the defendant's earth return, was held to be bad in law; but the second and more technical plea, that the Leeds Corporation (who are the real defendants, Mr. Baker being their contractor), were working the electric tramways under statutory powers, was held to be sound. The plaintiffs' rejoinder, that they were bound to exercise their powers with reasonable care to avoid being a nuisance to their neighbours, was also held to be sound, and, therefore, the question was reduced to the one of evidence—whether the defendant's "single trolly system" was as good a system as could reasonably be required of them. The learned judge held that the evidence showed it to be the best yet discovered, but that less than this was needed, it sufficed if their system were as good as other rival systems, and of this he had no doubt. It would be intolerable if a company should be required to adopt the latest invention of "ever-changing, ever-advancing scientific discovery," under penalty of being held liable for causing a nuisance. The grounds of this decision will hardly give as much satisfaction as the decision itself; it will be news to many people that there is no remedy for a nuisance caused by a company acting under statutory powers. It is said that in America, where earth returns are common, the electrolysis caused by the currents is continually rotting away the water and gas pipes; it seems that, if the like took place in Leeds, the public would have no remedy but to insulate their pipes.

TWO interesting and not unimportant decisions have lately been given in the Law Courts. That of Macdonald *v.* the Mayor and Corporation of Workington illustrates once more the rule that if contractors with their eyes open agree to perform certain work, and it proves to be more difficult and expensive than they expected, they are obliged at all cost to themselves to complete it. In the above case the plaintiff agreed to make a sewer for the defendants. Finding the work much more costly than he expected, the plaintiff asked to be paid the sum which was due in respect of the work so far as it was completed; but no certificate had been given by

the surveyor, nor would he allow alterations in the contract. The legal rights of the parties were therefore absolutely clear; the contractor had no choice but to complete the work at any cost. The Court of Appeal decided against his claim, as it was certain to do. Once again we repeat that if in the stress of competition contractors will undertake work without taking all points into consideration, they must from time to time find themselves in difficulties. The second case is that of Smith *v.* Legg, which raised an interesting question under the Metropolitan Building Act, 1855, namely, whether a building which has been completed can be ordered by a district surveyor to be altered so as to make it comply with the existing law. The Court held that the surveyor in giving notice after the building was completed was too late, and that the requisite notice must be give whilst a building is in course of erection. It is quite clear, as Lord Coleridge pointed out, that if buildings were to be altered or pulled down after completion very serious loss might be inflicted on the builder, and various odd complications might ensue if the building were sold or the builder were dead. On the other hand, it is all very well to say that a surveyor must go about his district with his eyes open, but when the notice required by the thirty-eighth section has not been given by the builder it is his default which is really the cause of the late notice by the surveyor to alter or pull down, and in a sense the builder has only himself to thank for the loss which may be incurred. However, probably the balance of convenience is in favour of the decision, which is not likely to be altered.

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WE have received a copy of some correspondence which has just taken place between Mr. Levy, M.P., and the President of the Board of Trade, on the subject of patents. In the course of his letter, Mr. Levy draws attention to the following among other points:—

"The granting of a patent in this country does little more than give the patentee a *locus standi* for litigation. When an applicant applies for protection, and takes out his patent, although there may be a seore of patents in existence covering what he proposes, he reccives no information or warning from the Patent Office that such is the case. In the United States, cn the other hand, one of the five points always inquired into by the examiners is the patentability of the invention, which among other things includes the question of novelty; and the fifth point is whether the claims interfere with any pending application. The examination as to the patentability of the invention comprises the questions:—

1. Is it an art—*i.e.*, a process, machine, manufacture, or composition?
2. Is it useful and important?
3. Is it new or improved?
4. Is it injurious or contrary to morality?

In determining the question of novelty, the examiner utilises the descriptions of prior inventions pertaining to the same subject in—

1. The specifications and drawings of domestic and foreign patents.
2. Other printed publications or manuscript digest of the same.
3. And may also utilise facts within the knowledge of employees of the Office, supported by declaration, the search being more or less extended according to the complexity of the invention and the antiquity of the art.

In Germany precisely the same questions are considered and reported upon by the examiners."

Mr. Mundella, in reply, while promising that the suggestion should receive careful consideration, points out that its adoption would involve a radical change in the principle and policy of the Patent Laws as amended by Parliament in 1883, and that there is little prospect of any legislation of this nature being undertaken during the present Session. We hope, however, that the subject will not be lost sight of. It is high time that something should be done to render the process of protection of inventions in this country more simple and less costly.

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THE lecture by Mr. J. J. Harris Teall, on the "Natural History of Silica," delivered on Monday afternoon at the London Institution, if not comprehensive, proved interesting. He commenced by explaining the crystallographic forms usually assumed by silica as exemplified by a quartz crystal, which may be described as a hexagonal prism terminated by hexagonal pyramids, and rough methods of measuring the angles were outlined. Referring to the origin of quartz crystals, he said that the theory so long held—even as far back as Roman times—had received a substantial check in comparatively recent years. The Romans thought that quartz was produced by the congelation of water, but M. Daubrée had artificially made quartz crystals, and had shown that they were formed out of material of certain composition, in the presence and under the influence of heat, pressure, and moisture. M. Daubrée enclosed a glass tube containing some water, in a steel cylinder, which was then hermetically sealed, and placing the whole in a furnace, heated it up to 400 deg. C. On opening the cylinder at the end of a week it was found that the glass had quite changed its character, it being then composed of crystalline materials, partly in the form of minute quartz crystals. By these experiments much light had therefore been shed on the mode of formation of crystalline silica in Nature's laboratory. The lecturer then drew attention to the formation of certain kinds of limestone by the accumulation of organic remains, and his remarks were illustrated by the aid of the oxy-hydrogen lantern. Photos of the sinter terraces which formerly existed in New Zealand were thrown upon the screen. Several kinds of sponges were also depicted, and special reference made to those which—like *Euplectella*—form their skeletons of silica, or strengthen their fleshy framework by the addition of siliceous spicules. Other organisms, such as radiolarians and diatoms, were well illustrated and briefly described. The lecturer remarked that the sponges, radiolarians, and diatoms referred to, obtained their silica from the water in which they lived. The proportion of silica in the ocean was comparatively small, but although a considerable quantity of this was daily abstracted by organic agencies, the constant waste of the land, and the furnishing thereby of a large amount of silica in solution, to the sea, compensated to some extent the amount abstracted. The occurrence of chert in certain geological formations was alluded to, and Mr. Teall concluded by announcing his recent discovery of chert containing radiolaria in Mullion Island, off the Cornish coast. We must confess to some disappointment of the lecture as a whole. Not a word was said respecting the formation of flint, nor of the agencies whereby that amorphous form of silica was produced; of the occurrence of silica as the matrix of certain sandstones, nor of the sandstones themselves; of the enormous masses of quartzite, nor of that quartz which enters so largely into the composition of granite and similar rocks; of "secondary" quartz, nor of the various minerals of the quartz family. In short, it may be said that many of the principal features of the subject were altogether ignored; and their places were occupied by rather lengthy illustrated references to the scenery and formation of Mountain Limestone and to the Great Barrier Reef of Australia,—interesting matters enough in their way, but having little or no connexion with the "Natural History of Silica."

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THOSE of our readers who have been to Nuremberg will remember the chief Market-place, with its "Frauen Kirche" and the "Schöne Brunnen," or beautiful fountain, and how the picturesque old square is spoiled by the rows of wooden booths and shanties which disfigure its southern side. These miserable market stalls were erected in the early part of the present century, and were let on long leases, chiefly to members of the Butchers' Guild. The Town Council has of late refused the renewal of the old leases, some of which expired at the end of last year; as they become vacant the stalls will be permanently removed, and the square will be cleared of these unsightly erections. The first batch will have disappeared during the present month.

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FROM the *Berliner Philologische Wochenschrift* (February 4) we learn that Madame Schliemann has placed at Dr. Dörpfeld's disposal funds to enable him to carry on a three months' further excavation on the site of Troy. Dr. Dörpfeld will begin his work about the middle of April. This will prevent his usual course of peripatetic lectures in the Peloponnese, but in place of that he will conduct a party of archæologists and students in a tour through some of the islands, for which purpose, as once before, a special steamer has been chartered. The steamer is to touch at Ægina, Poros, Delos, Mykonos, Eretria, Oropos, Rhamnus, Marathon, and Sunion. Names are received up to March 1.

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IT is stated that in consequence of the death of Lord Harewood, his mansion in Hanover-square is about to be sold. The house stands on the northern side of the square; it has an extended return frontage together with a quarter-circular bay and the stables along the eastern side of Harewood-place. The original elevations are shown in the early views of the square, looking northwards, by Sutton Nicholls, of 1720 (first state) and 1754; Overton (1727), and others. In, or after, 1776 Robert and James Adam designed and erected the present two fronts, with pilasters, bay, &c., for the Duke of Roxburghe.* The original drawings state that they were to be covered with the "Liardet" stucco, the invention of which formed the subject of the well-known leading case of "Liardet *v.* Johnson," the brothers Adam being virtually the plaintiffs. T. Malton published, in 1800, a good view in aquatint of the altered west front, together with a companion illustration of the red-brick house, recently demolished, at the north-eastern corner of Cavendish-square. On the Duke of Roxburghe's death the house in Hanover-square was bought by Edward, first Earl of Harewood, for whom Robert and James Adam decorated the interior of Harewood House, in Yorkshire, designed and built by Carr. The London County Council schedule the gates at the top of Harewood-place in their present Bill for the removal of several bars, posts, and similar obstructions in London.

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AN attempt on a large scale seems to be in process of organisation for providing hotel accommodation for exhibition visitors at Chicago. This is the "Andreas" hotel, which is being carried out under the direction of and for subscribers to the "World's Fair co-operative bureau." It is to consist of a series of buildings, each 620 ft. long by 30 ft. wide, separated by wide courts and connected by skylights and covered ways of fireproof material. The buildings, according to the illustration, are built in long parallel rows, and form a kind of huge gridiron over a large site not far from the exhibition, and connected with it by railway and tram service. Unfortunately we find that nearly all will be managed "on the principle of crowding as many people into a room as possible," with a vague "promise not to overcrowd." Probably there will be a good deal of overcrowding all over Chicago, and it may be better to be overcrowded on economical terms than to be overcrowded and fleeced; but we doubt if visitors to Chicago will have a very comfortable time of it under either system.

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WE have referred more than once lately to the extraordinary incapability of French architects and writers on architecture

* John the third Duke, we believe, the eminent book-collector, who succeeded in 1755, and died, unmarried, in 1804.

to look beyond their own country. A typical instance of this occurs in the last volume of M. Planat's "Encyclopædia of Architecture," which contains an article on the important subject "Pont," written by M. Planat himself. In this article illustrations of two or three of the Seine bridges are given, but no mention at all is made of Rennie's great work, London Bridge, unquestionably in every sense a more important work of its kind than any of the Paris bridges. But what will the reader say when we tell him that in this article on "Bridges" in what is intended to be a first-class and comprehensive work of its kind, there is actually no mention made of the Forth Bridge; and not only so, but there is no allusion to the cantilever principle of bridge building at all! This seems almost incredible, but it is the fact. We presume that as no French engineer has adopted the cantilever principle in a large bridge, it is to M. Planat as good as non-existent. The author of the article had better pay a visit to England and have a look at the Forth Bridge; perhaps his eyes will be opened a little then.

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THE following paragraph appeared in the *Evening Standard* on Tuesday last:—

"Lord Grimthorpe, by whose generosity the ancient Abbey of St. Albans, now the cathedral church of the new diocese, has been completely restored at an enormous cost, has signified his willingness to undertake the restoration of St. Peter's Church, another venerable edifice in the locality. The old church has been in a dilapidated condition for many years, and the offer of Lord Grimthorpe has been gratefully accepted."

We do not know how much money Lord Grimthorpe spent over St. Albans Abbey, but we do know that his operations on that building were carried out at "enormous cost" to the interest of the building. But to the average English public, as represented in the average newspaper, the giving of money is the one thing that is comprehensible. Whether the person who furnishes the funds on the condition of treating an ancient building as he pleases is competent to treat it architecturally is a question that would never occur to them, or which they would put aside as entirely secondary and of no consequence. Indeed, such is the apathy and ignorance on such matters in this country, that we may be thankful there are not a dozen wealthy men with a craze for acting as amateur architects, each desirous to pull some cathedral or church to pieces at his own cost, and for his own amusement. They would probably all get their own way, and be commended in the newspapers.

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## WHAT IS ARCHITECTURE, AND HOW CAN IT BE ADVANCED?*

BY PROFESSOR AITCHISON, A.R.A.

THE time that nearest approached the present, as far as architects are concerned, was some period during the early Crusades, when the Crusaders, those engaged as military engineers, and the pilgrims, as well as some of the clergy, had seen the monuments of Rome, Constantinople, Antioch, Syria, and Jerusalem, besides the buildings of the other countries they had passed through; for if we have not seen the principal monuments of the world, it is our own fault if we have not seen drawings and photographs of them. The Mediæval architects, however, had advantages that we do not possess; they belonged to an architectural age in which a lofty ideal, religion, had to be worthily embodied in buildings,—I may say it was a time when every abstract idea was at once translated into a material symbol. At that time architecture was almost the only safe outlet for the thought and energy of those laymen who were not soldiers, and who desired to exercise their powers without being burnt alive. I have little doubt that the religious monuments, besides satisfying the ideal of the day, were also found to be valuable, in a pecuniary point of view, to the sees or abbeys to which they belonged.

The relic, picture, or statue that a church enshrined, which worked cures, gave good luck, or prevented ill-luck, was doubtless the main attraction; yet these benefits were more loudly proclaimed and more strongly vouched for by a magnificent building. These attractions, combined with a splendid ritual, must have drawn multitudes; the bulk of whom lived in hovels in the midst of squalor and penury, but spread the fame of the saint and of the building. This popularity must have brought a large income, rich offerings, and valuable legacies; and the very confluence of people enriched the town. However much the people of those days were actuated by religious motives, we cannot suppose that the structure itself did not attract many. The Cathedrals and Abbey churches are attractive to us; we can even learn from them, and what must they have been when new, strange, and marvellous—when every workman was anxious to see what had been done in his trade, and to pick up what hints he could? Doubtless the magnificent temples of the pagans produced like effects, for besides bringing more sacrifices and gifts to the divinity, or, in other words, enriching the temple and its priests, the pagan temples were the only safe banks of deposit, and even if no usury were gained from the hoarded gold, the owner showed his gratitude for its safe keeping by costly gifts to the temple. In the present day the value of architecture as an advertisement, is only understood by publicans. The Mediæval architects, too, of the early Crusades were like the rest of the Western people, barbarians, who could not copy if they would; but were overflowing with energy and new thoughts, while their own architecture was far below the monuments they saw, in construction, finish, and expression.

The architects of Christendom have got very far in their education; they can not only do everything that has been done nearly as well as the original builders, but could with ease re-construct Caracalla's solar cell. You may perhaps recollect that Ælius Spartianus, who lived about 297 A.D., said "that the architects of his day affirmed that this solar cell could not then be built in the way it was done, for it is said that the upper lattice-work is of brass or copper, to which the whole roofing is trusted; and that so great is the span (about 76 ft.) that learned mechanicians would deny that they were able to construct it." Our architects, too, could paraphrase any style that there was a sufficient demand for, in such a way that it could hardly be told whether the building were old or new, and you must recollect what Michelet said, that "Gothic could only be done by celibates fired with religious enthusiasm;" there, however, their capacity apparently ends.

The sudden abandonment of the proper study of architecture at the dawning of the Renaissance partially accounts for this, for the immense gap now to be bridged over—that is, from the cessation of Gothic to the present day—wants at least a whole century of attempts, by properly educated men of genius, before it can be expected to be bridged. The spirit of the age, too, is adverse to the expression of abstract thoughts by symbols or concrete forms, while the necessary and unnecessary unsightliness of so much around us makes the task still more difficult.

Architects have adhered to Nature's ways, that is, to try and make most things shapely, while the age is, I think, necessarily indifferent to shapeliness; for, as I have so often pointed out, directly you have a new weapon you want to use it, and it is not until the first rude weapon has brought increased spoil and leisure, that there is time or inclination to beautify it. The engineers, on the contrary, after having taken up construction at the point where the architects abandoned it, have worked at it in the true spirit of the age, for utility alone; so that with those new but powerful materials, cast and wrought iron and steel, they have carried construction beyond the very dreams of ancient madness, but without the smallest regard to the shapeliness of the objects they construct. I was once amused by an engineer declaring with the greatest pride to a body of architects "that his profession was absolutely indifferent to how anything looked; their aim was to make the structure answer its purpose, with the smallest quantity of material consistent with safety," and that "they never wasted a thought on anything else"; yet, in spite of this, they have occasionally stumbled into producing sightly structures. It is mainly from this consideration that I said we may possibly fall into the proper shapeliness, by following, as far as we can, Nature's methods.

If an investigation into the construction of former buildings was not wanted to show us how it affected their shape and appearance, my remarks on construction would be brief. I should say, you have at hand a current construction that you understand and use for common purposes, or may understand, if you take the trouble. To use deceased construction is pedantry. Former architects used the best form of construction they knew or could invent, and so should you.

There is no building that you will ever have to erect whose largest space an iron girder will not span, and with concrete you may make an incombustible roof or floor—at least one that cannot be burnt from the top. The Roman groined vault was not beautiful, not even interesting, except from a constructional point of view; nor were Gothic groins, until you got complex ones made for appearance sake, like those at the Cathedral at Oxford and elsewhere. If it be said that there might be cases in some lands inhabited by savages, where you could get neither iron nor steel, and where ballast, coke, and Portland cement were unknown, I say a problem is proposed that seems to me like the one given me to solve in my childhood:—

> "If all the land were paper,
> And all the seas were ink,
> And all the trees were bread and cheese,
> What should we do for drink?"

It is time enough to think of solving this problem when we meet with it.

In early times the materials mostly determined the construction; the main in-door occupations and the climate the shape. The early Greeks, who are supposed to have come from Asia Minor, probably lived near forests, and timber was therefore plentiful, and they used it.

The improved cottage or hut was probably an oblong chamber, and had an enclosed porch at the front, for the enjoyment of shade and the refreshing air; the porch was formed by the projection of the side walls,—and I use the word "walls" as we speak of "wooden walls,"—with the roof running over it; if the space between the outer walls was very wide, the squared lintel running from side to side probably sagged with its own weight, and so a couple of tree trunks had to be put under it to support it and its load; while, to shorten the bearing between them, a block or cap was put on the top of each trunk. As the dwellers in the cottage got better off, and their family more numerous, an open verandah was made all round the cottage. These two forms were the main types of the temples; the first was called "in antis," and the second "peripteral." The ends of the cross-beams of the roof, projecting a trifle over the lintel, were eventually carved into triglyphs, and the metopes were left open for light and ventilation. We know this was the case in the early temples, for, when Iphigenia was in Tauris, and fled with Orestes, they smuggled out the idol of Diana by the metope. The mutules were the ends of the rafters, which were balks of timber laid almost close together.

Some have imagined that the Greeks knew the arch,—the first mention of the arch is said to be by Aristotle; but if they did know it, we cannot believe that they were such idiots as not to use it, for to get up a stone architrave into its place an inclined plane of earth had to be made, and then the architrave had to be rolled up it to its position; this was much too serious a matter to have been long continued, when each stone of an arch could be carried up a ladder on a man's back. We have Pliny's account of the difficulty of getting the architraves of the Temple of Diana at Ephesus into their places, but he does not say of which temple he speaks; there were certainly eight temples! I am far from saying that the Greeks might not have persisted in using the lintel for temples, on acccount of religious conservatism, even when they knew the arch.

The Romans had at least been shown the use of the arch when the Etruscans built the Cloaca Maxima for them—whenever that may have been, for by some it is attributed to the period of the kings, and by others to the early Republic, though it is generally said to have been built in the days of the Greek King Tarquinius Priscus, 616 B.C.; but if it were built in Tarquin's days, it is strange that no one mentioned the arch before; the Etruscans are said to have had much intercourse with Corinth, and Aristotle was not born till 384 B.C. and died in 322, while the Athenian masterpieces were built about 440, nearly 200 years after the Cloaca Maxima is said to have been built.

Leon Battista Alberti was, I believe, the earliest Renaissance antiquary who examined a Roman wall. He gave a correct cut of it in the Italian edition of 1565. When Leoni edited a new edition of Alberti's works (1726) he showed the face of the wall, formed of brick triangles, but left out the rubble filling; and Palladio, though he was for years studying the Roman ruins, showed the wall faced with oblong bricks, but he had observed that it was filled with rubble.

* Being the third Royal Academy Lecture on Architecture this Session. Delivered on Monday evening, Jan. 30.

I do not know if antiquaries have settled when the arched and vaulted structures formed of a brick network filled with rubble were first built, nor when the brick skins were first used, since M. Choisy discovered these systems. If antiquaries have settled the dates, their information is buried in archæological journals.

As soon as the Romans had completed their system of construction they filled their whole empire with vast buildings, but few very high ones have come down to us, even if they built them. Martial's account of the height of Domitian's Palace may have been mere flattery :—

"The sun salutes it with his earliest ray.
On highest hills 'tis night when here 'tis day."

(Martial's "Epig.," Lib. 8, Epig. 36.) The tomb of Hadrian, now the Castle of St. Angelo, is supposed to have been the highest building erected by the Romans after Martial's day, said to have been 300 ft. high to the top of the pine cone which was supposed to crown it, but did not, as the pine cone was a fountain. The Colosseum is said by Fergusson to be 157 ft. high, and the Pantheon 147 ft. We think that if the Romans had been left to themselves, their buildings in this brick-faced concrete would not only have proclaimed their origin, but would have shown some marks of the strong and vigorous character of the people, and signs of originality; but this was not to be. All Roman knowledge and learning came from the Greeks, and the Greeks were too far above them in all artistic work to render originality possible. The Romans were never completely free from the thraldom of the Greek post and lintel, which was looked on by them, almost to the last, as a sign of what in the cant language of the day is called "art-work;" so that except in structures of pure utility, like the aqueducts, there is always some post and lintel architecture applied to their vaulted buildings.

Our grandfathers were very like the Romans, for they repeated the Roman expedient. A man wanted a house built, and though he was content that the exterior should be a dead wall with holes in it, both he and the architect wanted to be considered as men of taste; a Grecian Doric or Ionic porch was consequently added in wood or lath and plaster. Whatever may be said, English architects are now in advance of this. The fronts of the Roman baths have a mixed aspect; some parts are treated with columns and architraves, while some have only arched openings. Palladio shows some of these arched openings with columns made into Venetian windows; whether he found sufficient traces of this form to justify him we cannot say, for the text, if written, has never been found.

The principal features that were new in the outsides of Roman buildings, besides the arches, were the circular curves of the exedræ, with their half domes, and domes themselves; for externally the groined vaults were mostly made up with concrete to the form of a roof, and covered with tiles. At what times these arched and domed forms appeared externally we do not know. Domes are mentioned by Vitruvius, who is said to have been born in 80 B.C., and may have lived into the Christian era, for he says to Augustus, to whom he dedicated his book, that his face was wrinkled with age. (Vit., Lib. 2, Præf., par. 4. Augustus was Emperor from 27 B.C. to 14 A.D.) Vitruvius describes the domes (hemisphæria) of the hot room (laconicum) and of the Sudatories of the baths, and he also speaks of the *Tholi*, painted by Apaturius, of Alabanda, for the people of Tralles; but I do not know when Apaturius lived. These Tholi are commonly called domes, though they may merely have been hemispheres not of domical structure. At what date the domes and semi-domes at the baths at Pompeii were constructed is equally unknown. Pompeii was destroyed in 79 A.D., in the reign of Titus; but as this is not an antiquarian paper, the dates do not much matter. There were two circular buildings at the Baths of Titus, probably domed, but it by no means follows that they showed externally as we see at the Temple of Jupiter, in Diocletian's villa at Spalato, and elsewhere. There was one large and two smaller domes—possibly octagonal—at the baths of Caracalla, three at the baths of Diocletian, and three at the baths of Constantine. The only large antique dome at Rome that shows externally, besides the ruined one of Minerva Medica, is that of the Pantheon; this has lately been discovered to be not earlier than the days of Hadrian —117-138 A.D. The external steps, however, that abut its base, give it a depressed and ugly appearance, and the outside of the smaller dome of Sta. Sophia, at Constantinople, is not much more beautiful.

There is another constructive feature in all the baths, and also in the basilica of Maxentius, as shown by Palladio, namely, spurs or buttresses on either side of the tepidarium or the nave, to abut the thrust of the groined vaults at the springing. These buttresses may be said to contain the germ of the flying buttress, for almost all have an arched opening through them. These buttresses alone would show that the central chamber was vaulted. One part, however, of the applied Greek work became an important constructive feature with the Romans, the column with a slice of entablature over it, for it bore a part of the weight of the groined vaults, and if the drawing that Palladio left of Agrippa's baths showed the original baths, then this column and slice of entablature had become a feature of Roman architecture before Agrippa's death (12 A.D.). The springing of arches direct from the capitals of columns is first met with in Diocletian's villa at Spalato (before 313 A.D.).

The building domes on a square by means of pendentives did not affect their external appearance. The first attempt at pendentives we know was in the octagon halls of the peribolus of Caracalla's baths. (Caracalla reigned from 211 to 217 A.D.)

One particular device of the Byzantines had a great effect on the appearance of their buildings, that is, the making of the abutments internal; this plan was subsequently adopted by the Gothic architects for the same reason,—the increased internal area gained by it; the spaces between the external buttresses at Notre Dome of Paris were eventually enclosed and turned into chapels.

The main external feature that was added by the Byzantines was putting a drum to the dome—but I am ready to admit that the cause of it may have been æsthetic; still, it involved two constructive discoveries: first, that the four arches and their four pendentives would bear a drum; and, secondly, that a dome could be made that required no external abutment.

The central lanterns and small domes on drums that were put into various churches to bring light into parts that would otherwise be dark were constructive features, but can, perhaps, hardly be classed as wholly constructive.

In this rapid sketch it is impossible, even if it were advisable, to enter into smaller constructive improvements that affected the external or internal appearance of buildings.

The early Christian churches in the West, which could only be vaulted over the aisles, from want of means and skill to turn and abut the larger vaults of the nave securely, suffered terribly from fire, both wilfully and accidentally caused. All the Pagan savages and barbarians, who over-ran or made raids on Christian countries, always burnt the churches; but besides this, so large a part of the towns had the houses thatched or shingled that a fire in the town accompanied by strong wind was very liable to set the churches on fire. Sta. Sophia at Salonica was damaged by fire through the burning pieces of wood being blown in through the open windows, and firing the combustible goods stowed in the mosque, and thus calcined some of the columns, and damaged the mosaic.

In addition to these causes, the Mediæval churches were frequently fired by lightning: consequently there was a most ardent desire to protect them from these causes of destruction. When the wandering tribes had settled down in the eleventh century, all the efforts of the architects were directed to the making of incombustible ceilings; and at this very time vast multitudes of the Westerns were travelling through Europe and Asia to the Holy Land. In this same eleventh century copies of the Church of the Holy Apostles at Constantinople had been erected in Venice and in Périgueux: each church was of the cross form, and vaulted and domed with five domes; that of St. Mark was built of brick, veneered with marble and mosaic in the old Roman way; that of St. Front at Périgueux was made of cut stone left bare. By the successful vaulting and doming of these naves the Westerns saw their problem solved.

I must digress a little here. It was the fashion in the early part of this century to vaunt Roman work, as far as constructive daring went, at the expense of Gothic. It is true that the Romans had built vaults surpassing the Gothic ones in span, 80 ft. not being unusual, and I believe that these have only been exceeded at St. Peter's at Rome; and no dome of so great a span as the Pantheon has ever been erected in masonry: but this fact should be considered, by those who desire to judge rightly and with justice—that the Romans had the tribute of the whole civilised world at their disposal, or, at least, of that part that surrounded the Mediterranean; all these countries were subject to the Roman Government, and excellent roads ran from Rome to the remotest parts of the Empire: not to speak of herds of slaves being at their command, not only of those born in the Roman Empire, but those taken from the savages and barbarians beyond it, and it is probable that the Roman carts and cattle were as good as their roads.

It seems to me as reasonable to compare these structures of the Mistress of the World with those of the poor Mediævals, to the disadvantage of the latter, as to compare a house built of brick by a man of small means with the marble palace of an American millionaire; but even this comparison would be too favourable, for besides the difference in wealth, the countries where the Mediævals built were cut up into small feudatory states, so that the materials coming through them were subject to every sort of exaction, and often to confiscation or robbery. The roads were execrable, even if they could be dignified hy the name of roads, and I believe the carts and cattle well matched the roads. Probably the spare serfs of the neighbourhood were all the people that could be got to do the unskilled labour, though doubtless, in some cases, the skilled workmen were impressed; but in either case the number must have been small. And yet, with all these disadvantages, such was the zeal, energy, ability, and skill of the architects, that though their buildings were not perhaps equal in area to the Roman baths, their towers were carried higher than anything the Romans built, and fell little short of the height of the great Pyramid,—in fact, Old St. Paul's, of London, exceeded it in height.

Now to take up the broken thread of my story: When the Mediævals saw a church wholly roofed with stone, they wanted to avail themselves of its advantages, but the cost stood in their way. M. Corroyer, whose admirable book on Romanesque Architecture is in every architect's hands, makes this curious deduction, that would be incredible were not fact stranger than fiction: namely, that though the Mediævals were conversant with groined vaults, that it was the domes of Angoulême and its neighbourhood that gave rise to the regular Gothic groin. He says that the demand for these domes, by those who could ill afford the cost, induced the architects to use a rib in place of the pendentive, and to make these ribs independent and the framework for a thinner dome; and that eventually they gave up the normal jointing of the dome, and, though mainly keeping the form, merely filled in between the ribs with vaults; the thrusts, thus concentrated on a point, were abutted by the flying buttress, so that when there were two or more aisles and chapels as well, and the art of construction was at its height, the Gothic cathedral was, except at its west front, a sort of stone porcupine; the ranges of pinnacled piers that carried forward and downward the thrusts of the nave and choir vaults made a bristling array round them like a guard of spearmen about a *catafalc*.

There is only one internal Mediæval feature purely due to construction that I need mention,—the arches. I think Professor Willis calls these single and double stepped arches "orders" ("Remarks on the Architecture of the Middle Ages." R. Willis: Cambridge, 1835), but the constructive expedient is obvious: the Mediævals were quite as parsimonious as the Romans, and with less means, so they naturally wanted to save the expense of unnecessary centering. The first arch was often not half the width of the wall, but when it was turned it acted as a centre for the next arch, the voussoirs of which overhung it on both sides, and when this arch was keyed up it had no longer need of support; in some cases there was a third arch, which was also corbelled over, the second one acting as its centering. The tracery of windows may also be looked on as a constructive expedient to get more light, but of course, the shapes of the piercings were adopted for æsthetic reasons, and were doubtless suggested by Saracen work.

We cannot expect to find any new constructive improvement in the early Renaissance, and, so far as I know, there is none; nor is that to be wondered at, for we do not expect to see improvements made in any art by those who do not understand it, and, if in addition to this, traditional schools are broken up, and well-understood methods of improvement abandoned, we should expect it still less. When the Roman Empire was broken up by the incursions of many tribes of savages, the schools and guilds were extinguished; yet some of the skilled men probably escaped, and when these savages began to permanently settle down, skilled men were sought for and built the structures the barbarians wanted. Theodoric's palace at Ravenna is an example, and his tomb, if really executed at the time, shows that a very skilful architect must have been found. The heads of the Christian faith, such as

Gregory the Great, forbade the destruction of pagan buildings. The Abbeys started schools of architecture and of all the subsidiary arts, and we must recollect that these bodies were affiliated to others in all parts of the world, so that any new inventions, discoveries, or improvements made by the architects of Constantinople, Syria, or Alexandria could be brought to every other country where Christianity was established, and there be taught in the schools. Those students who were advanced and promising could first be put on the works of new abbeys or churches that were being carried out, and when experienced enough could be used to carry out the designs sent by the mother abbey. How this tuition and experience was gained when the architects were formed into lay guilds we do not know, but probably a similar course was pursued. At the Renaissance the ecclesiastical fetters on the human mind were removed, and man was comparatively free to pursue what studies he liked, to despise asceticism, and enjoy with a light heart all the pleasures that could be found on this earth. A much wider knowledge of the masterpieces of classic poetry and eloquence was spread, and printing by movable types soon made books much cheaper, and thus increased the number of readers. Statues, bas-reliefs, bronzes, coins, and gems, were more sought after and admired, and the impending ruin of Constantinople caused great numbers to be exported.

The seeing this earth turned from a vale of tears into a vale of joy made the people of the day hate the old church, while the superiority of the ancients in all artistic work made the Renaissance men not only desire to equal their masterpieces, but made them hate and despise the old ecclesiastical arts, and think that the Romans were perfect. The Renaissance men took to writing in Latin, imitated every bit of Greek or Roman sculpture they could find, and called Gothic "the tasteless style"; so architecture fell in Italy into the hands of scholars, antiquaries, goldsmiths, painters and sculptors, who thought that the last word of architecture was said by Vitruvius, and was to be found in the Roman ruins. Why has the fame of Brunelleschi been so widely spread? Simply because he was an able sculptor who had never even studied architecture, but by dint of genius, intellect, and the study of Roman ruins, was able to raise the walls and build the dome of Sta. Maria del Fiore without centering, that Arnolfo de Lapo had designed and provided for. Large domes were built before his time without mankind having heard of the architects' names. The architect of Hadrian's Pantheon is unknown; many domes were built in Constantinople and Turkey in Europe shortly after Brunelleschi's day, that have caused no sensation; and the architects of the Mediæval cathedrals are practically unknown.

The present head of the constructive part of our profession is Sir Benjamin Baker, who has built the most wonderful bridge the world has yet seen, 1,700 ft. in clear span; but unfortunately people hardly hold their breath when he appears, because he was brought up as an engineer; but if the gifted President of the Royal Academy were to build one nearly as big, it would be considered miraculous, and the whole world would be agog. But I ask you, would this be the way that any sensible man would set about improving construction? Are we to wait till a heaven-born genius arises, who can solve the problems wanted, without the proper training?

We are in a scientific age, and mathematicians have for centuries past been investigating the problems we want solved, and others are still engaged in advancing this science. Are we to ignore their labours and trust to genius? or are we to learn how to solve these problems ourselves by the aid of statics?

The Mediævals had little science,—very little was known in their day,—but it is believed that what they did know they used; their main source of information was keen observation, remembrance, reasoning, and experience. They built just as a chair-maker does: he thins away the skeleton of the chair till it crumples up under a sitter, and then he knows the slightness has gone too far. Even to sit on chairs that are too slight involves some risk; but there is much more danger in unsafe buildings, and by a knowledge of materials, and the laws of statics, we may avoid all risks. Probably, most people would so far agree with me, but I insist that a knowledge of statics does a great deal more for us; it gives us the proportions we should use. I have never had any doubt that the proportions of the antique stone or marble columns, architraves, archivolts, and the like, were deduced from the observation that these proportions would mostly stand without failure. Time and custom have greatly aided in making us think the proportions beautiful: though you are not to suppose that the harmonious proportioning of a building and its parts is not one of the master arts of architecture.

If statics tell us that the best form for a cylindrical cast iron column is from 25 to 30 diameters high, we shall learn to think those proportions beautiful, and in the same way with every other part. The abacus of a column is to carry the superincumbent weight securely on to it, and we shall learn to admire the proportions of the abacus that does this; so, again, with arches, if we have to use them we shall learn to like the shapes they ought to take.

It is quite certain that some shapes of pointed arches which appear unpleasant to us, pleased the people of the Middle Ages; but even if it be admitted that we are right and they were wrong, it does not follow that the arches themselves were exactly of the shape they should have been. Nature herself is infinite in her proportions, and makes the bulk of her works beautiful; but she does not hesitate to alter her proportions, if I may be allowed such an expression, to make her creation the best for all its purposes under the circumstances, nor does she hesitate to make things ugly, if an ugly form best meets the requirements of the case. She never completely falsifies her laws, but under certain circumstances she allows some of these to seem in abeyance. Most solid things in Nature crystallise if left free, but so few things are left free that but few natural crystals are found. Whenever we are able to observe and examine one of her organisms, and to discover all its surroundings, we find it perfectly fitted for its purpose. When we are only partially acquainted with an organism and its surroundings we may find fault; and certainly when we know nothing about certain organisms, and can only judge of them by the eye, we see that some are much more beautiful than others. Yet in their forms and colours we find the greatest subtlety displayed, and those means followed to produce effect, that in man's work we should call artful devices. I merely mention this to show that we may make some little sacrifice for the sake of beauty when beauty is required.

We see that by following out purely constructive forms the engineers have sometimes produced things that are a pleasure to look on, particularly at a distance; there is a bridge at Berwick-on-Tweed that, seen from the railway on a moonlight night, is quite lovely; its loveliness is of course accidental, and it is by no means beautiful when seen close; but if the English were lovers of the beautiful, the whole country would be full of such bridges, for the builders would learn the means of producing such effects in the distance, if they were really desired. I have no doubt that the Italian builders of the vast farmhouses in the Campagna studied these methods, for these *casali* are mostly ugly and ill-proportioned when one is close to them, but highly picturesque at a distance. The Crystal Palace again, though heavy and leaden-looking outside, is wonderful inside, and produces strong emotions from the brilliancy of its light, its vastness, slightness, and height; and this happens mainly through the mere effort to cover a large space economically. We cannot, however, give all the credit to the engineers, as Sir C. Barry and many other architects had a hand in it.

I think I have now shown you that the construction of former buildings did, to a great extent, determine the peculiarities of their external appearance, and I would ask, are our powers of invention so great that we can afford to abandon these means of giving character to our buildings? Would it be wise to depend only on our skill as ornamentalists for our future immortality? I ask each architectural student if he would rather be the man who tattoed the New Zealander, or the power that made him? and in saying this I will put aside any question of our originality and skill in ornamentation.

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"HEALTHY HOMES."—Mr. Allan Greenwell, A.M.I.C.E., of the Frome Rural Sanitary Authority, has just delivered two lectures, at the Temperance Hall, Frome, on "Healthy Homes, and how to keep them healthy," under the auspices of the Frome Technical Education Committee. There has been a good attendance at both lectures, we are informed, there being no charge for admission. Mr. F. Parsons, M.R.C.S., Medical Officer of Health to the Frome Local Board, presided at the meetings. Mr. Greenwell has been instructed by the same committee to deliver further lectures in their district on "Air and Water.'

## THE INSTITUTE OF BUILDERS:

### ANNUAL MEETING.

THE ninth annual general meeting of this Institute was held at the offices, 31 and 32, Bedford-street, Strand, W.C., on Tuesday, the 7th inst., the chair being taken by the President, Mr. Herbert H. Bartlett.

The Secretary, Mr. Richard S. Henshaw, read the accounts, and the following report of the Council was received and adopted:—

"1.—The Council have the pleasure to present their Ninth Annual Report.

2.—Owing to the general election, the Council have had no Parliamentary work of importance to undertake during the past year, but they would impress on members the certainty of increased liabilities being enforced on employers of labour by the extension of the Employers' Liability Act, in the near future, and the necessity, therefore, of a united front being shown by all employers, so that fair and equitable conditions may be sought for.

3.—During the past year the London County Council have made a new departure, by resolving to employ their own labour, and carry out public works themselves.

4.—The action of the London County Council in undertaking work, and the payment of wages regulated by the trades unions, will doubtless very materially and disadvantageously affect the building trade, and is, in the opinion of the Council,* entirely opposed to the public good.

5.—The Council in the early part of the year received further communications from the Royal Institute of British Architects, with reference to the proposed Conditions of Contract, and appointed a sub-committee, consisting of Messrs. H. H. Bartlett, H. T. Ashby, S. G. Bird, Frank May, and Wm. Shepherd, to meet the representatives of the Royal Institute of British Architects. The Conditions were then discussed, and have been now referred to the solicitors of both bodies with the view of completing the same, and the result of their deliberations is awaited.

6.—Although the building trade has not been interfered with to the same extent as it was last year by the strike and lock-out of carpenters and joiners, it has, during the last twelve months, been considerably disturbed through the agitation in the labour market.

7.—The Council have the pleasure to present the audited accounts of the Institute, and the Library and Benevolent Funds for the year 1892.

8.—In accordance with the Articles of Association, the President, Mr. H. H. Bartlett; one of the Vice-Presidents, Mr. R. Neill, Junior; the Treasurer, Mr. George Plucknett; one of the Auditors, Mr. George Burt, Junior, and four Members of the Council—Mr. John T. Chappell, Mr. Thomas Hall, Mr. Benjamin Hannen, Junior, and Mr. J. H. Trollope retire, but are eligible for re-election, with the exception of Mr. J. H. Trollope, who does not desire again to serve."

The following officers were then elected and re-elected—President, Mr. Frederick J. Dove; Vice-Presidents, Mr. Joseph Hill and Mr. R. Neill, Junior; Treasurer, Mr. G. Plucknett; Members of the Council, Messrs. J. T. Chappell, Benjamin Hannen, Junior, G. J. Lough, Colin G. Patrick, and George Hayward Trollope; Auditor, Mr. George Burt, Junior.

The proceedings terminated with a vote of thanks to Mr. H. H. Bartlett for his services as President during the past year.

## CENTRAL ASSOCIATION OF MASTER BUILDERS OF LONDON:

### ANNUAL MEETING.

THE twenty-first annual general meeting of this Association was held at the Offices, 31 and 32, Bedford-street, Strand, W.C., on Tuesday, the 7th inst.; Mr. Thomas F. Rider, F.R.G.S., President, in the chair.

The Secretary, Mr. E. S. Henshaw, read the accounts, and the following report for the past year was received and adopted.

"1. The Council have the pleasure to present the Twenty-first Annual Report of the Association, which is the first since its late reorganisation on what was considered to be a more popular basis, namely, by the formation of District Associations, each electing members to the Council.

2. In June last a Committee appointed by the Council met representatives of the various branches of the building trades, and after lengthened discussion agreed upon a code of working rules, which came into force in November last, and have been generally accepted and adhered to, both by masters and men. As this is rather an important matter, marking, as it does, a new departure in dealing with labour questions in a broad and comprehensive spirit, by negotiating simultaneously with all trades, a history of the proceedings may not be uninteresting. Members will recollect that in November,

* The word "Council" here used of course means the Council of the Institute of Builders.—ED.

1891, Mr. J. Macvicar Anderson delivered his award in the arbitration with the carpenters and joiners, and hopes were entertained that a period of tranquillity might ensue; but on March 1, 1892, an application was received from the Operative Bricklayers' Society, asking for an increase of wages and a reduction of working hours. The Council appointed a committee to confer with the representatives of the Society, and after two meetings, a resolution was arrived at, to the effect that it was desirable for representatives of this Association to meet delegates from all trades, with the object of arriving at a common code of working rules. Conferences were held on June 10 and 23, when the rules were agreed to with all trades except plumbers. A further conference with the representatives of the United Association of Operative Plumbers of Great Britain and Ireland took place on October 24, when a satisfactory arrangement was arrived at, the ½d. per hour advance being conceded, and the principle agreed, that plumbers should, whilst always having one hour for dinner, cease work at the same time as other trades.

3. The Council having empowered the Strike Committee to deal with any questions arising out of the interpretation of the new rules, they conferred with representatives of the Operative Bricklayers' Society, the Operative Stone Masons' Society, and the United Builders' Labourers' Union, and it was decided:—

'(*a*) A workman leaving work of his own accord, after having given one hour's notice, is to be paid on the following Saturday with the other men, but where a man shows reasonable cause for quitting his employment during the week, it is customary for him to receive a ticket for payment at the yard, but in this case no walking time is allowed.

(*b*) Banker masons at work in shops on jobs where there is artificial light, shall be subject to the same rules as such men working at the builders' yard.'

4. Members are doubtless aware that a Chamber of Arbitration has been established, under the auspices of the Corporation of London and the London Chamber of Commerce, and the Council nominated as desirable referees for the building trade, the President for the time being of the Institute of Builders (Incorporated), the President for the time being of this Association, and Messrs. Stanley G. Bird, George Burt, D.L., J.P., Frederick J. Dove, and Benjamin Hannen.

5. The Council, in the hope of dealing quickly and effectively with trade questions as they arise, have appointed a Standing Committee on Trade Questions, with power to call either one or all trades together for conference when necessary, and they sincerely hope that this may tend in the future to prevent the disastrous policy of resorting to strikes and lock-outs.

6. The Council also have to express their obligations to Messrs. Stanley G. Bird, J. H. Bridgman, John M. Burt, John Grover, and H. J. Wright, for the valuable evidence they gave before the Royal Commission on Labour.

7. The Council trust that the members of the Association will use their best endeavours to increase its numbers, and would point out to the officers of the several District Associations the importance of using their influence to induce those members of the trade in their localities, who have not yet done so, to join the Association.

8.—In accordance with the rules, the audited accounts will be presented to the meeting, and it will be necessary to elect two auditors and three elected members of the Council. The three elected members of the Council who retire are Messrs. G. J. Lyall, R. Thorn, and Wm. Scrivener, who, being eligible, offer themselves for re-election."

Various subjects of interest to the trade having been discussed, the proceedings terminated with a vote of thanks to the Chairman for presiding over the meeting, and for his valuable services in connexion with the labour questions which had arisen during the past year.

## THE INSTITUTION OF MECHANICAL ENGINEERS.

THE first general meeting of the year of this Institution was held on Thursday and Friday evenings of last week in the Theatre of the Institution of Civil Engineers, when the two following papers were read and discussed: "Description of the Experimental Apparatus and Shaping Machine for Ship Models at the Admiralty Experimental Works, Haslar," by R. Edmund Froude; and "Description of the Pumping Engines and Water-softening Machinery at the Southampton Water Works," by William Matthews, Water Works Engineer. The first paper dealt with a part of a very interesting subject, and one which, though naturally of importance chiefly to naval architects, contains many features of mechanical interest, owing to the original and ingenious manner in which the details of the apparatus have been worked out. The experimental works at Haslar are a branch of the Naval Constructor's department at the Admiralty, and here models of ships of new type are actually tried in order to ascertain the speed the vessels will reach under given conditions of power, displacement, &c. For this purpose there is a tank, or canal, 400 ft. in length, and along this the models, made of paraffin wax, are towed by a locomotive truck on which is placed the dynamometer to register the resistance offered by the hull. There are other uses to which the tank may be put. When it is remembered how great is the difference in size between a small model and the ship itself, it will easily be seen that accuracy of work is necessary to give true results.

The paper by Mr. Matthews is more particularly interesting as the Southampton Waterworks comprise by far the largest plant yet laid down for water softening by the lime process. Of course this system is very far from new, the East Surrey Water Company having adopted the Clark process in the works at Caterham in 1861, and since that date there have been some other examples of the system of greater or less importance. The Southampton works, in addition to being the largest, are also nearly the most recent, having been inaugurated in 1888, and contain most of the recent improvements; indeed the Atkins system, as seen at Southampton, is a very different thing to the original Clark process. There is so much hard water in this chalky isle, and water itself is growing to be so precious a commodity, that the subject of the paper in question is likely to become one of considerable importance, and the proceedings of last Thursday at the Institution of Mechanical Engineers' meeting afford valuable information. The author commenced by describing the pumping machinery, which does not appear to include anything very novel. There are two pumping stations, one at Mansbridge, on the River Itchen, about three miles from Southampton. This station was established in 1851, and contains a pair of single acting Cornish beam engines and a pair of rotative beam engines. This supply was found to be unsuitable, and the civic authorities determined to go further afield. A spot was accordingly selected at Otterbourne, up in the chalk downs about six miles on the road to Winchester. Here a pair of compound surface-condensing rotative beam engines by Simpson & Company, of Pimlico, were erected. These run at a speed of eighteen revolutions per minute, and can pump 2,000,000 gallons every twenty-four hours. Each engine is independent, having its own crank-shaft and fly-wheel. The cylinders are steam-jacketted, and are placed side by side in line with their beam, so that they are of different stroke. The high-pressure cylinders are 28½ in. diameter by 4 ft. 9 in. stroke, and the low-pressure cylinders, 38¼ in. diameter by 7 ft. stroke. These engines work at 60 lbs. pressure, which appears very low in these days of triple expansion and steel boilers. The fact did not escape criticism in the discussion on the paper, but both the President of the Institution, Dr. Anderson, one of our most experienced authorities on waterworks engines, and also the author upheld the desirability of low pressures and slow moving engines. Undoubtedly high piston speed and high steam pressure give the best trial trip results in the matter of fuel economy, and in districts where coal is dear this will always carry great weight. But for steady, continuous work, year in year out, the lower pressure and more deliberate movement has undoubtedly the advantage, a fact which should also be remembered in cases where engines have to be erected far from foundries and machine-shops. In addition to this the older type has the advantage in not requiring so much attention in those minor particulars which cannot be classed under the heading of renewals and repairs, but, nevertheless, necessitate shutting off steam for a greater or less period of time. In connexion with the question of fuel economy it may be stated that the old Cornish engine, which ran at 15 lb. pressure and made ten strokes per minute in ordinary work, consumed 4·7 lb. of Welsh coal, per I.H.P. per hour, whilst the old rotative beam-engines at Mansbridge, working at 30 lb. and making 12½ revolutions per minute, consumed 4·9 lb. of Welsh coal, per I.H.P., per hour. On a trial made with the new Simpson engines at Otterbourne, the coal consumption per I.H.P. per hour was found to be between 1·67 and 1·74 lb. per I.H.P. per hour. This is a good result, and no doubt would be approximated in regular working considering the very high duty the manufacturers have got out of their pumping engines. The mechanical efficiency of the engine is between 84 and 85 per cent, but this is taking into consideration the friction of water in the pipes, so that a higher figure of merit should be allowed, as Professor Kennedy pointed out at the meeting.

The water softening machinery is however the chief point of interest. It is capable of dealing with about 2,500,000 gallons per twenty-four hours, but by suitable additions 4,000,000 gallons per day could be treated. We believe that up to the present the largest average quantity of water softened per day at any other works has been about 900,000 gallons per day. This figure has only been reached at the well-known Colne Valley Company's works at Bushey. The softening process, as is well known, consists of treating the hard well water with a paste of lime, when the carbonate of lime which forms the hardening constituent in the water unites with the lime forming bi-carbonate of lime, which is precipitated in insoluble crystals. Mr. Matthews did not enter into the chemistry of his subject in his paper, but it will perhaps be of interest if we give an analysis of the Otterbourne water, both before and after softening, supplied by the author on another occasion.

| | Well water in parts 100,000. | Softened water parts in 100,000. |
|---|---|---|
| Total solid matters ..... | 31·69 ..... | 14·07 |
| Organic carbon ..... | 0·024 ..... | 0·021 |
| Organic nitrogen ..... | 0·012 ..... | 0·013 |
| Ammonia ..... | 0·005 ..... | 0·004 |
| Nitrogen as nitrates or nitrites ..... | 0·365 ..... | 0·381 |
| Total combined nitrogen ... | 0·381 ..... | 0·397 |
| Chlorine ..... | 1·6 ..... | 1·6 |
| | Degrees. | Degrees. |
| Hardness, Temporary ..... | 16·10 ..... | 3·92 |
| ,, Permanent ..... | 1·89 ..... | 2·10 |
| ,, Total..... | 17·99 ..... | 6·02 |

The author divides the softening process into three operations:—The preparation of cream of lime; second, the preparation of lime water and its admixture with the hard well water; third, the filtering of the turbid water after softening. The cream of lime is prepared by mixing slaked lime with water in suitable apparatus. Softened water is then pumped in with the cream of lime and the two well mixed together. The resulting lime water is then taken to the mixer, where it meets the hard well water which requires to be softened, and here the chemical action takes place. It now remains to separate the resulting insoluble crystals of bicarbonate of lime from the water and to deliver the latter clear for use. In the old arrangement this was effected by means of large settling tanks, which not only occupied a great deal of room, but were expensive to work. For these have been substituted filters, of which there are thirteen at the Southampton works. The filters consist of a number of flat circular vessels mounted on a horizontal spindle, and placed in an open-topped tank or trough. The filtering material is cotton cloth mounted on perforated zinc, and the zinc in turn is supported by light cast-iron discs. The hard water is pumped into the troughs, and then percolates through the cloth into the space between two discs, the bicarbonate crystals being arrested on the outer surface of the cloth. The clear water then passes into the interior of the horizontal shaft, which is made hollow for the purpose, and from thence is pumped away to the mains. It should be stated that the cloth itself is not an efficient filter for arresting the bicarbonate, and when a cloth is first put in the water has to be pumped back to be refiltered. Very soon, however, a layer of crystals forms on the surface of the cloth, and has the effect of arresting other crystals. This self-filtering action is well known in connexion with various other industries. After a time the layer becomes so thick that water will no longer pass through, and then a clearing device has to be brought into play. The hollow horizontal shaft, in which the discs are mounted, is hung in trunnions, so that it can revolve. Between the discs, and, pointing upwards, are spray pipes, perforated with holes in their length. In this way jets of water are made to play upon the filter cloths whilst the discs are revolving. The surplus material is speedily removed, and, falling to the bottom of the trough, is washed away through a waste valve.

The cost of softening is now 0·2 penny per thousand gallons, exclusive of charge for sinking fund, which is about another ¼d. per 1,000 gallons.

The summer meeting of the Institution will be held this year at Middlesbrough, commencing Tuesday, August 1.

ARCHITECTURAL PARTNERSHIP.—Mr. Horace Cheston, of 5, Union-court, Old Broad-street, informs us that from December 31 last he has taken into partnership Mr. J. C. Perkin, who was articled to Messrs. Paley & Austin, of Lancaster, and who has been with Mr. Cheston for over nine years. The name of the firm in the future will be "Cheston & Perkin."

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# Illustrations.

## DESIGN FOR PAINTED GLASS.

THIS design, by Mr. E. J. Chapman, is a modern imitation of the favourite Renaissance treatment of stained glass by painting in an open manner on the white glass ground, irrespective of the divisions of the bars which hold the glass. The colouring is of a light and delicate tone, as required in this style of work. The design was exhibited at the last Royal Academy Exhibition.

## PART OF EAST WINDOW, BATH ABBEY CHURCH.

WE gave some months ago an illustration from a drawing by Miss Emma Knight of part of the west window of Fairford Church. The present illustration is from a drawing of part of the west window of Bath Abbey Church by the same lady, who has shown a special talent for reproducing in water-colour the effect of stained glass windows; both this and the Fairford drawing found a good place in the Architectural Room of the Royal Academy.

The Bath window is a fine example of modern stained glass by Messrs. Clayton & Bell. The window is of great size, rivalling the west window of York, and the glass illustrates the life of our Lord, in fifty-six compartments, surmounted by the usual figures of angels, apostles, and evangelists. In the spandrils on either side are the arms of the City of Bath and the Diocese of Bath and Wells.

## DESIGN FOR A RAILWAY TERMINUS: SOANE MEDALLION, 1893.

THE subject of a great railway terminus is a recurring one in prize competitions, and as there is no book on the subject, the student meets with considerable difficulty in obtaining the necessary data. In the first place, the Board of Trade rules will be found in Molesworth's Pocket-book; and secondly, a few examples are to be found in the *Builder* of the following dates:—Strassburg-Paris, November 3, 1849; Great Western, London, June 17, 1854; King's Cross, October 2, 1851; Cannon-street, October 13, 1866; Holborn Viaduct, June 17, 1876.

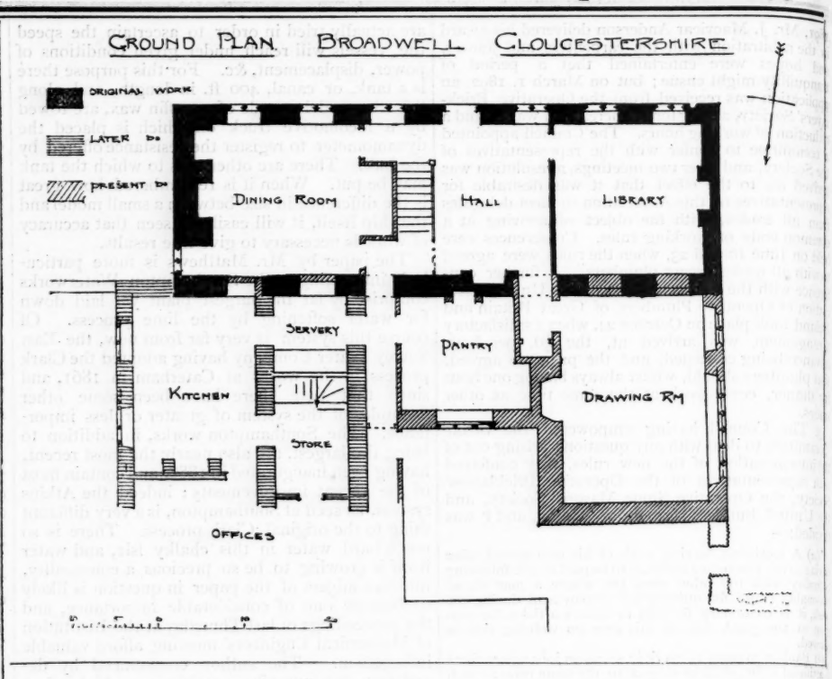
Of these illustrations that of King's Cross is especially interesting, because it shows the great arches terminated by gables, instead of horizontally, as at present. It would be very interesting to know why the change was made, as it might have been on account of the curved outline of the roofs, to which the present form is probably better suited. The façade in this case is the end of the sheds, the approach being at the side, as in the Great Western, consequently the treatment is not complicated by the necessity for a large booking hall. The problem of the booking hall consists in the fact that it must either go inside the shed, like a temporary structure, or be treated as a low block in front of the main feature of the façade, the end elevation of the shed. In the first case it spoils the inside elevation of the station, and in the second diminishes the effect of the great gable by hiding its base, though the back front of the Paris Opera House shows how this latter defect may be, to some extent, obviated.

The present design follows a third course, the first two lays of the shed being, as it were, cut off, and treated as a grand hall, whose vault is marked on the elevation by an arch of the same section, while the gable lines are those of the railway shed. Hence the filling-in of this arch must be regarded from the point of view of the hall inside, as well as being an incident in the general elevation of the station.

The treatment of the design as a whole is that of the King's Cross type, the great arch, however, being brought to the front face of the supporting masses, which are here treated as towers, and thus the arcade at the base becomes an internal gallery at the first-floor level, forming the link between the main office corridors on either side of the shed. The width of this gallery is the depth of the towers, and over it is a coffered vault, which affords rigidity to the front arch, and would, it was thought, increase the effect of the main vault. Towers in railway design seem rather out of place; here it is an excuse that they mark the through entrances at either end of the great hall, which are a leading feature in the plan. There are two such entrances at Charing Cross, though Holborn Viaduct has only one. They are very useful for the luggage trucks as well as for passengers who have season-tickets. The separate entrance required to the company's offices has been placed in the centre of the main side gable.

The London stations are mostly obscured by hotels, and those in Paris differ radically from our plans owing to the Consigne de Bagage and Salle d'Attente systems. Travellers tell of the German termini, but there is little information to be obtained on the subject. It would be a fine subject for a Godwin Bursary student to study; collected plans and notes of the Continental termini would form a most valuable report.

A. T. BOLTON.




## HOUSES, MACKENZIE-STREET, SLOUGH.

THESE houses are built of brick; the lower part and chimney-stacks covered with Portland cement, rough cast; the upper part and roof with red tiles.

The house on the right hand has waiting and consulting rooms, &c., for a doctor; and the house on the left has solicitor's offices, with separate entrances.

The builder was Mr. G. Wernham, of Princes-street, Reading. The architect was Mr. Walter Cave, of London.

## BROADWELL, GLOUCESTERSHIRE.

THIS is a very interesting house, built about the latter end of the seventeenth century. The original plan is a good type of many houses in the Cotswold country—the square, stone-paved entrance-hall, with large open fireplace, the general living-room on one side, and the great kitchen on the other.

Upstairs the corridor along the southern front, with the bedrooms opening from it, and facing the north and east, a custom in those days, when it was thought unhealthy to have sleeping-rooms towards the sun.

The house, however, has been considerably altered, probably towards the beginning of this century, when the kitchen wing and offices were added, and the arrangement of the rooms upstairs altered, changing the corridor to the north side.

The new drawing-room and rooms over were added about three years ago, and complete a very charming house. The dining-room, a finely panelled room of the original date, has been altered and enlarged, and the inside of the house generally has been made more convenient. The dormer gables being similar on both sides of the main roof, the new wing had to be kept lower, so as not to interfere with the light. There are several good panelled rooms upstairs, and stone arched fireplace openings. The new work has been built of old lichen-covered stones, and the old mullioned windows, &c., built in again, and the roofs are covered with local stone-slates.

The work was carried out by a local firm of builders, Messrs. Howman & Son, of Stow-on-the-Wold, from the designs of Mr. E. Guy Dawber, of London.

## *ARCHITECTURAL SOCIETIES.*

MANCHESTER SOCIETY OF ARCHITECTS.—At a general meeting on Tuesday last, Mr. Salomons, President, in the chair) Mr. H. Ross, of Accrington, was elected a Fellow, and Mr. A. J. Murgatroyd an Associate of the Society. A paper was read by Mr. John Slater on the "Buildings of the Ancients," which was illustrated by numerous diagrams and listened to with much interest. The Royal Institute of British Architects' prize drawings were on view in the room.

## *ARCHÆOLOGICAL SOCIETIES.*

BRITISH ARCHÆOLOGICAL ASSOCIATION.—At the meeting of this Association on February 1, Mr. Allan Wyon, F.S.A., in the chair, the progress of the arrangements for holding the annual congress at Winchester was detailed. Mr. E. Ebblewhite exhibited some late Roman coins obtained by him in Germany. Mr. Earle Way described a curious silver medal of Francis Bacon. He also exhibited a drawing of Antiquity Hall, near Oxford, a building now demolished. The first paper was on the sculptured crosses at Otley Church, Yorkshire, by Mr. J. Romilly Allan, F.S.A. Scot. During the restoration of the building a few years since, a considerable number of carved stones were found, either under the flooring or embedded in the walls, having been reused as old material. These prove to be fragments, for the most part, of the shafts of ancient crosses, and they are covered with carving of scrolls and interlaced patterns. A wyvern, carved in high relief, appears on two sides of one of the fragments. Another has busts of saints or ecclesiastics above one another, each under a semicircular arch. There are seven or eight of these fragments, one having figures carved in a different style, similar to the work on two or three examples elsewhere which have been called Danish, with great probability. Mr. Park Harrison pointed out the similarity of the patterns to those on early Saxon MSS., and suggested that the hands that could design their patterns could equally prepare these for the stone carvers. Mr. Loftus Brock, F.S.A., believed that the fragments must be of date anterior to the Norman Conquest. Norman ornament was well known, but not a single pattern here was in the style of that period, as would certainly have been the case were the date later than the Conquest. Full-sized rubbings of all the stones were exhibited.

A second paper was read by Mr. Cecil Davis, on the "Royal Visits to Wandsworth."

A CORRECTION.—In publishing Mr. T. Rogers Kitsell's drawings of Siena pavement last week, we described him by an oversight as "Soane Medallist, 1892." We should have said "Tite Prizeman, 1892." Mr. Kitsell informs us that he has never competed for the Soane Medallion.

## LONDON COUNTY COUNCIL.

THE usual weekly meeting of this Council was held on Tuesday afternoon at Spring-gardens, the Chairman, Mr. John Hutton, presiding.

*Tenders.*—Tenders were received for the erection of a Fire Brigade Station in Cherry Garden-street, Rotherhithe, and for repaving Hammersmith Bridge. We print the lists of tenders in another column.

*Technical Education.*—The greater part of the sitting was taken up with the consideration of the Report of the Special Committee on Technical Education. The report contained the following passages and recommendations :—

"On the 9th of May last, we were directed to consider what action the Council should take under the Technical Instruction Acts, 1889-91, and the Local Taxation (Customs and Excise) Act, 1890. We have held numerous meetings, and made exhaustive inquiry into the matter—a task which has been prolonged by various difficulties, but in which we have received the most cordial assistance from the London School Board, the City and Guilds Institute, the Charity Commissioners, many of the City Companies, and indeed from all persons engaged in educational work.

In order to enable the Council to come to a decision on the subject, we thought it necessary to obtain a complete and systematic survey of the existing provision of technical education in London, a survey which had not hitherto been made by any authority. We were fortunate enough to obtain for this purpose the services of Mr. H. Llewellyn Smith, M.A., B.Sc., who has acted as our secretary, and whose able and exhaustive report has been circulated to the members of the Council. We believe that this report, containing as it does information never before published, and presenting a comprehensive scheme for the systematic co-ordination of London's educational agencies, will, in itself, be of great and lasting use to all who are concerned with public education.

Mr. Smith's report shows that excellent work is being done in different parts of London ; but it also reveals how seriously the existing provision for technical education falls below the standard, we do not say of Zurich, but even of such English towns as Birmingham or Manchester. London contains a larger artizan population than any other city, but its skilled trades are being largely recruited from the provinces, whilst Londoners, from lack of proper training, swell the ranks of unskilled labour or the 'unemployed.'

Perhaps the most serious deficiency is the inadequate provision for evening instruction, on which, at present, the son or daughter of the London workman or clerk must so largely rely. About 100,000 children leave the London elementary schools every year, nearly all of whom ought to be found in the various evening institutions for the three or four next years of their lives. London ought, therefore, to have (besides adults) 300,000 or 400,000 young persons in its evening classes.

Yet the total numbers of persons of all ages attending evening classes in London in any branch of science, art, or technology appears to be under 20,000, of whom 1,400 are in the evening classes under the School Board. Three years ago Manchester, with one-tenth of the population of London, had already one-third as many persons attending evening classes. Since the Manchester Town Council determined to exercise its powers under the Technical Instruction Act, 1889, the number has been more than doubled, and Manchester has now, in proportion to its population, six times as many persons attending evening classes in technical subjects as there are in London.

Still more striking are the statistics for particular trades. In 1891 there were about 25,000 bricklayers within the County, of whom nearly 3,000 were under 20. The number receiving instruction in brick-cutting was about 50 ; in the principles of bricklaying only about 40, a total which has since been slightly increased. The total number of operatives in all the building trades was about 140,000, of whom 15,000 were under 20 ; yet the number of them who were attending classes on the vitally important subject of building construction and drawing was less than 800. About 30,000 men and boys are at work in London in the printing and lithographic industries ; only 140 of these were in 1891 getting any kind of technical instruction connected with their work. London has about 46,000 workers in the cabinet-making and upholstery trades, of whom 7,000 are under 20. The total number who were last year receiving technical instruction in their craft (including designing and carving) was under 120. Only three out of the 10,000 persons employed in London's tanneries, and only ten of its colour workers, were learning any branch of chemistry. . . .

In view of the facts revealed by Mr. Smith's report, we are unanimously of opinion that it is of the utmost importance that the Council should no longer abstain from exercising its powers with regard to technical education. Every other municipality in England having power as a county council to assist technical education is now exercising that power. The experience of these municipalities shows how greatly the assistance of the Council could increase the efficiency of the whole educational machine, especially by way of co-ordinating the work of the existing agencies and by supplementing their scattered efforts.

No other public body has the power to undertake this function ; and it is in the highest degree unlikely, even if Parliament were disposed to treat London differently from other towns, that any new and special authority for this purpose could be established for years to come. Meanwhile, the Science and Art Department, on the assumption that the Council will exercise the powers entrusted to it, has so modified its grants to science and art classes, that the continuance of these in London is in some cases seriously imperilled ; and Mr. Smith tells us 'that many of them have only continued to be held at all this autumn in the hope that the deficiency in the Science and Art grant would be made good in some form by the Council.'

We therefore recommend that the Council should resolve :—

'(1) That, in view of the importance of London not falling behind other cities in the provision of technical education, it is desirable that the Council should exercise its powers under the Technical Instruction Acts, 1889 and 1891, other than that of raising a rate, by devoting to technical education some portion of the funds from time to time receivable under the Local Taxation (Customs and Excise) Act, 1890.'

If the Council adopts the foregoing resolution, some arrangement must be made for carrying out the very extensive work of considering the needs of every district, the claims of the several hundred diverse and often competing educational institutions, and the manner in which their action can best be co-ordinated and supplemented. The Council may either retain the whole work in its own hands, or exercise the power given by the Technical Instruction Acts of delegating it to a composite committee appointed by the Council, but not necessarily confined to its own members.

After careful consideration, we are of opinion that the Council should appoint such a composite committee, and delegate its powers. We are led to this conclusion, not only by the importance of securing the co-operation of other educational agencies and of acting in close concert with them, but also by the difficulty of adding to the already overcrowded agenda paper of the Council. . . .

The Technical Education Board would, of course, as regards the moneys contributed by the Council, be limited both by the terms of the Acts and by any conditions which the Council might from time to time impose. But the possibility should be kept in view of the Board being hereafter entrusted, as London's main governing body for technical education, with funds from other sources, both public and private. The Council has, on more than one occasion, indicated its view that the recommendations of the Royal Commission on the City Companies should be carried out, and that a large part of the funds now administered by these bodies should be devoted to London's educational needs. One difficulty in the way has hitherto been the lack of any public authority specifically charged with technical education. It may be suggested that the establishment of a Technical Education Board, and its successful working with such limited funds as can be placed at its disposal by the Council, would go far to remove this difficulty, and enable a strong case to be made out for the further endowment of the Board from any funds that may be available, whether from the City Companies, parochial charities, or other sources. Such a Board might indeed obtain with further funds a higher and more permanent status, by charter or otherwise, than any committee of the Council.

We have carefully considered the composition of this proposed Board. We think that the Council should maintain the ultimate control of its proceedings by having a majority of its own members on the new body. We regard it as of great importance to secure the close co-operation of the London School Board, which supplies technical education in elementary schools, and, to a small but increasing extent, in its evening classes. It would also be desirable to obtain the cordial assistance of the City and Guilds Institute, which is, at Finsbury and South Kensington, providing admirable instruction in the highest grades of technical science. The Polytechnics form so important a part of the existing provision for evening education that we should be glad that the Council should have the assistance of representatives of their ultimate governing body, the Trustees of the City Parochial Charities. The Head-Masters' Association and the National Union of Teachers might each usefully assist the Council in the work. And, as we think it of special importance that the cordial co-operation of the trade unions should be secured, we suggest that the London Trades Council should send a representative. As soon as a teaching university for London is established it would be desirable to obtain the assistance of one or more representatives of its work. But the Board should not be of too unwieldy a size. We therefore recommend—

'(2) That, in order to promote efficient and united action, it is desirable that the Council should delegate, so far as is permitted by law, its powers in respect of technical education to a composite body, to be called the Technical Education Board, to be appointed by the Council, partly from its own members, and partly from other persons whose co-operation is desired.

(3) That the Technical Education Board should be appointed for a term of three years, and should consist for the present of not more than *thirty-five* members, of whom *twenty* should be members of the Council ; that in the first instance the following bodies should be requested to nominate representatives for appointment by the Council, viz., the London School Board *five*, the City and Guilds Institute *three*, the Governing Body of the City Parochial Charities *two*, the Head Masters' Association, the National Union of Teachers, and the London Trades Council *one* each ; and that other members, not exceeding *two*, should be selected by the Council from outside its own body.

(4) That the Technical Education Board should be directed to present to the Council, in the month of April in each year, a report of its proceedings during the preceding financial year of the Council, together with detailed accounts of all payments out of the funds administered and a complete list of the institutions aided by it ; and that interim reports of the progress of its work should be presented to the Council every three months.'

It is a question whether the Council should guide the deliberations of the proposed new Board by any detailed plan or scheme. The able and comprehensive proposals of Mr. Llewellyn Smith's report will, of course, be considered by the Board, and the Council may think it desirable to merely express its views as to the need for adequate provision being made for each district and every class. We think that this course is preferable to the formulation, in advance, of any detailed and necessarily rigid scheme, We therefore recommend the Council to resolve—

'(5) That, without committing itself to details, the Council considers that every district of London ought to be adequately provided with technical education of every grade, rising from the school to the workshop and the university, and appropriate to the chief occupations of its inhabitants ; that existing institutions of each grade should be systematically co-ordinated to avoid overlapping, and to provide for continuous education ; and that early provision should be made, in whatever manner may be found expedient, for supplying the gaps at present existing ; and that the Council, recognising the value of the comprehensive report prepared by Mr. Llewellyn Smith, refers it for the general guidance of the Technical Education Board.'

There remains the question of the amount of money to be devoted by the Council to technical education. If this were to be decided solely by the amount required for a really adequate provision for all branches of technical education, the sum would far exceed the limit of the Council's powers. Even to bring London up to the level of Manchester or Birmingham will require the expenditure of many hundreds of thousands of pounds. But it is obvious that the bulk of this expenditure must come from other sources than the County Fund. What is now necessary is that such a sum should be appropriated as will provide for the most pressing needs, and enable a beginning to be made in the work to be ultimately completed with other aid. After careful consideration of Mr. Smith's report, we have come to the conclusion that, in order to deal fairly with all districts and provide for the more necessary subjects, a sum of about 60,000*l.*, in addition to the 30,000*l.* already set aside, should be appropriated to technical education for the ensuing year.

This would involve the devotion to this purpose of about one-third of the funds receivable by the Council under the Local Taxation (Customs and Excise) Act, 1890. It will be remembered that the great majority of Town and County Councils have devoted the whole of their receipts from this source to technical education. London is less advantageously situated ; and, pending some financial relief to the occupying ratepayer, we think that appropriation of one-third of this fund would be a reasonable provision for the ensuing year. We therefore recommend—

'(6) That, subject to an estimate being submitted by the Finance Committee, as required by the statute, this Council is of opinion that the sum of 29,000*l.*, being the balance of the sum of 30,000*l.* directed by resolution of the 12th of April, 1892, to be carried to suspense account, should be appropriated and contributed in respect of the year ending 31st March, 1893, for the purposes of Technical Education ; and is further of opinion that a sum equal to one-third of the total amount estimated to be receivable by the Council under the Local Taxation (Customs and Excise) Act, 1890, in respect of the year ending 31st March, 1894, should be similarly appropriated and contributed ; and that it be referred to the Finance Committee to submit to the Council the necessary formal resolutions.'

If the Council should agree to the foregoing recommendations, it will be necessary that various preliminary arrangements should be carried out before the appointment by the Council of the Technical Education Board can be actually made. We therefore recommend—

'(7) That the Special Committee on Technical Education be continued, and authorised to make any necessary preliminary arrangements, until the appointment by the Council of the Technical Education Board referred to in the foregoing resolutions.'"

Mr. J. Williams Benn moved that the following words be added to recommendation 1 of the Committee :—

"Provided that the City Livery Companies be called upon to contribute for the same purpose a sum of not less than one-tenth of their corporate income as distinguished from their trust property."

Mr. Hubbard seconded the amendment, and after a good deal of discussion, in the course of which some very hard things were said of the City Livery Companies, the addendum was agreed to in the following terms :—

"And that the City Livery Companies be requested to

contribute for the same purpose a fair proportion of their corporate income as distinguished from their trust property."

The recommendation, as thus added to, was then agreed to.

On the second recommendation being put, Mr. Fred. Henderson moved, and Mr. Lemon seconded, an amendment referring the matter back to the committee, "with the instruction that the Council was not prepared to delegate its powers in the manner suggested." The amendment was lost by a large majority, and the recommendation of the committee was agreed to.

Recommendation 3 was still under discussion when the debate was adjourned.

After transacting other business, the Council rose at 7 o'clock.

## *COMPETITIONS.*

THE FIELDS ESTATE, NEWPORT, MON.—In an open competition for designs for laying out eleven acres of the Fields Estate, Newport, for building purposes, there were six competitors, and eight sets of plans were sent in. Messrs. Veall & Sant, architects, Cardiff, were appointed professional assessors, and they have just sent in their report, awarding the premium of £25 to the design marked "Fairfield C," the author of which proved to be Mr. Alfred Swash, architect, Newport.

ST. CUTHBERT'S CHURCH HALLS, EDINBURGH.—According to the *Scotsman*, it has now been decided to proceed with the erection of new church halls in connexion with St. Cuthbert's Church, on the site of the old manse buildings, and adjoining the site of the old halls in King's Stables-road, recently demolished in connexion with the North British Railway extensions. The Kirk Session, on the recommendation of Mr. John Honeyman, F.R.I.B.A., Glasgow, their assessor, have approved of the design submitted in competition by Messrs. M'Arthy & Watson, architects, Edinburgh; and the erection of the buildings is to be proceeded with at once. The site is an irregularly-shaped triangle, and being below the level of the road the design required a special treatment. The building is placed lengthwise to King's Stables-road, and consists of two floors. The upper floor, which is approached from the level of the roadway by a broad terrace and a short flight of steps at the entrance door, is entirely occupied with the hall, which is seated to accommodate 800 adults. There are also suitable retiring-rooms. The lower floor is occupied with a smaller hall, class, and retiring-rooms, and caretaker's house. The cost of the buildings is 4,000*l.*

## MAGAZINES AND REVIEWS.

THE *Gazette des Beaux Arts* devotes a long article, by M. André Pératé, to the Sienese painter Duccio, with a page illustration of his painting of the Virgin surrounded by angels, in the curious stiff Sienese style, with the aureoles like a series of plates on the picture. M. A. Darcel in his third article on "La Céramique Italienne" treats of and illustrates the work of Caffagiolo. Tapestries at the Spanish "Exposition Retrospectif" by M. Mazerolle (with an engraving of a fine chasuble from Toledo); the eighteenth-century sculptor Clodion and his work, by M. Guiffrey; and an article on the Italian Schools at the Vienna Museum, are among the other contents of the number.

The *Art Journal* shows for frontispiece a delicate engraving of Mr. Vicat Cole's "Westminster" picture, which looks a great deal better in engraving than it does as a picture. The first of a series of articles on "Tynedale, its castles, churches, and tributaries," by Mr. Edward Browne, is given, with several illustrations of castles of the district, reproduced from photographs. In a short article on "Blake and his disciples" Mr. A. T. Story recognises the importance of Calvert's work. An article by Mr. Henry Wallis on the Cernuschi collection of Chinese and Japanese bronzes is of interest, and well illustrated.

In the *Magazine of Art* architecture is not represented this month, but Mr. Walter Crane concludes his significant and beautifully illustrated article on "Design." "The Art Life of John Leech," by Mr. H. Silver, introduces us in the illustrations to some landscape sketches of Leech's (a light in which he is not much known), and reproductions of some of his delicate drawings of figures. An illustrated article on "Dagnan-Bouveret," by Prince Karageorgevitch, may introduce a fine artist to some who do not already know him. There is also an article on "Suggestions for a New Fine-Art Copyright Bill," by the Editor, with contributions from Mr. Holman Hunt, Mr. Seymour Haden, Mr. Briton Riviere, Mr. H. T. Wells, Mr. John Brett, and Mr. Poynter. Mr. Haden suggests that "the first difficulty attending the drawing of any Bill for the protection of works of art is to determine what *is* a work of art"; a pithy suggestion of what is sometimes overlooked.

*Harper's Magazine* contains some illustrations to "Twelfth Night" by Mr. E. A. Abbey, which as supposed realisations of the characters of the play we should call for the most part complete failures. There is an article on "New Orleans," by Mr. Julian Ralph, with sketches; a more interesting one on "Bristol in the time of Cabot," by Mr. J. B. Shipley, with some representations of old buildings of the period from various sources; and the "Editor's Study" contains the kind of puff of Chicago Exhibition art which seems inevitable in all American magazines at present.

In *Scribner* Mr. E. H. and Mr. E. W. Blashfield endeavour to realise, in a charming article, the position and daily life of "The Florentine Artist," of whom they enthusiastically observe, "Eternal youth was there, and its sublime confidence and audacity; they had not even found out what they could *not* do." "Impressions of a decorator in Rome" is concluded, in the course of which the author falls severely on Michelangelo's Last Judgment; but, like Mr. Horne, admits the ceiling of the Sistine as the finest decorative painting in the world. The whole article is well written and suggestive.

The *Century* contains an article entitled "An Art Impulse in Turkey," by Mr. G. P. Peters, referring to Hamdy Bey's museum at Constantinople and its contents, with some illustrations of the beautiful Greek sarcophagi there.

In the *Fortnightly Review* Mr. F. T. Piggott, whose notes on Japanese art in our columns will be remembered, gives some "Stray Notes on Japanese Art," mainly a description of methods of execution, also of the new Europeanising school of painters, who have fallen into the sin of endeavouring to "cover the paper." Mr. J. S. Jeans contributes a paper on the "New Railway Rates" from the point of view of the trading community, and concludes that Government must interfere to "bring the railway companies to their senses," if they do not put more reason into their demands.

In the *National Review* Earl Russell and Mr. B. H. Thwaite combine in a short article on "Electricity in Country Houses," concluding by recommending country people to combine together in groups to establish centres of electrical supply for the general good, if possible within easy reach of railways.

To *Macmillan* Mr. Cecil Smith contributes an important article on the "Ruins of Persepolis," remarking that "when the general history of the world's art comes to be written, a large and important place in its pages will be occupied by Persia."

The *Atlantic Monthly* gives a review of Mrs. Rensselaer's book on "English Cathedrals" entirely from the French-American standpoint, and adopting the new cant that there is "no true Gothic in England." The reviewer depreciates Mr. Pennell's drawings as not doing justice either to himself or to the buildings. There is also a very pleasant article on "English Cambridge in Winter," by Mr. A. G. Hyde, an American writer (if he is American) who seems to feel the charm of the old world which hangs about our two university towns. They are not of the day or the hour: "We would gladly teach you," the old buildings seem to say, "some of the secrets of those fast vanishing days; the secrets of repose, of religion, and of beauty, but between us there is a gulf fixed which we cannot pass. You must come to us, and in some faint measure become even as we ourselves, before you can hope to understand the mystery which we have in our keeping." Amidst the current American fashion of sneering at everything English, this is rather refreshing.

The *Cornhill Magazine* devotes an article to a description of a visit to the Thames Ironworks and Shipbuilding Company, under the title "Cyclops in London."

In the *Quarterly Statement* of the Palestine Exploration Fund, the Rev. G. E. Post's "Narrative of a Second Journey to Palmyra" is continued. There is a long article by the Rev. A. H. Sayce on "Cuneiform and other inscriptions at Lachish," and one by the same contributor on "The Site of Kirjath-Sepher" or "Book-Town." The most important contribution is Mr. F. J. Bliss's Report of the Excavations at Tell-el-Hesy during the spring of 1892. This gives a plan and photographic view of the excavations, with illustrations of various objects found. A part of the space in the book is occupied by a reprint of the rather foolish correspondence which some pious but credulous people got up in the *Times* a little while ago about a new imaginary "sepulchre of Christ," which was to be purchased by public subscription. Major Conder's reply (which seems, however, to have had little effect in bringing these enthusiasts to reason) is also reprinted.

The *Antiquary* contains a protest on behalf of the Lady Chapel of Gloucester Cathedral, threatened with a severe restoration, for which an appeal is made. The *Antiquary* naturally goes rather further in protests of this kind than we should always think it necessary to go, antiquaries in general wanting to have nothing touched at all, which will not always do, but we feel some fear that matters will be carried too far at Gloucester. Mr. Lines contributes an article on "Celtic Remains at Llanfairfechan." "Notes on Archæology in Provincial Museums" (No. XVIII.) deals with Gloucester; Mr. Ward comments, among other things, on the curious mixture of the cathedral town and the seaport in modern Gloucester.

The *Essex Review* continues its notes on Essex churches, dealing in this number with St. John the Baptist, Danbury.

The *Canadian Architect and Builder* (monthly) appears with a "New Year" number for January, containing an extra number of illustrations, mostly reproduced from photographs of actual buildings, which give the idea that Canadian architecture is in a quiet and safe road of conservatism, not to say commonplace.

The illustrations in the *Architectural Review* (Boston) are more remarkable for their good execution than for the designs. In a "Sketch for a Cathedral of St. Matthew, Dallas, Texas," the architects (Messrs. Cram, Wentworth, & Goodhue) have done all they can, not only to assimilate a Mediæval style (Perpendicular), but to convey in the drawing the idea of an old building. Did it not occur to them that such buildings were once new? A "Portion of an elevation of a house," by Messrs. Rotch & Tilden (executed work, apparently), looks like a combination of the Lysicrates Corinthian order with doorways from the Erechtheion.

The *Revue Scientifique* for February 4 includes a short article by M. Le Chatelier on "La Théorie et l'Empirisme en Matière de Constructions Métalliques."

The *English Illustrated Magazine* contains a paper on "Scottish Castles and Residences of Mary Queen of Scots," with some picturesque illustrations by Mr. George Reid; the article has no special value apart from the illustrations.

## MASTER PLASTERERS' ASSOCIATION: ANNUAL DINNER.

THE first annual dinner of this Association was held in the "Queen's Salon" of the Holborn Restaurant on Thursday, the 2nd inst., Mr. C. Peek, President, in the chair, supported by a considerable number of members of the Association.

The Chairman having proposed "The Queen and Royal Family,"

Mr. E. T. Taylor, Treasurer, proposed "The Master Plasterers' Association," coupled with the name of the President. The Association was one of the most recently-formed of the many societies connected with the building trade, and was not yet, in fact, a year old, but although it was one of the youngest of societies, it was one of the most vigorous and successful, and was meeting an hitherto unsatisfied want. He hoped and believed that the plastering trade would flourish in the near future more than it had done of late, and that when architects found that they could rely upon plasterers' work being carried out with skill and integrity they would put more of it into their drawings. The toast was very heartily received.

Mr. Peek, the President, in replying, referred to the circumstances which had led to the formation of the Association. The master plasterers of London had hitherto been wholly unorganised, and had suffered much owing to the arbitrary conduct of the leaders of the operatives, who had industriously and malevolently encouraged the idea that the master plasterers of London were the greatest "scampers" to be found in the building trade. He repudiated such unfounded insinuations, which, he said, were due to the ill-will, not so much of the men themselves, as of their leaders. He maintained that no man could succeed in the plastering trade unless he did good work, and contended that the allegations which had been made against the plastering trade by the leaders of the men were insults to the intelligence of architects, clerks of works, builders, and foremen. The master plasterers of London wished to uphold the honour of the craft and desired to do good work, and to employ men at good wages to do that work. The Association had been formed to advance the interests of the craft, and they desired to promote not only the welfare of the masters, but the true interests of the workmen.

Mr. Charles Turner proposed the health of the Chairman, who had, he said, done a great deal to ensure the success of the Association.

The President briefly replieed.

Mr. S. Wright, Secretary, next proposed "The Craft," and in an able speech referred to the great antiquity of the plasterers' art. It must date back, he said, to a period little later than the time

"When wild in woods the noble savage ran."

Soon after the first carpenter had erected the first log hut, the first plasterer must have been called in to stop up the chinks, so that the cold air should not come through and chill the occupants. In more civilised times, as in those of ancient Egypt, the plasterers' art attained a much higher development, both for practical and decorative purposes. He could instance no greater or more striking evidence of the nobility of the plasterers' art than the hieroglyphic decorations which adorned the ancient temples and catacombs of Egypt,—decorations which were really historical records. Having characterised the many noble specimens of plaster ceilings, &c., to be found in many of the ancestral homes of England, as monuments of craftsmanship, he said that the members of that Association were capable of doing good work at the present day, and he hoped that in their efforts to improve the craft they would have the support and assistance of the architects. In conclusion, Mr. Wright gave some particulars as to the aims and objects of the Master Plasterers' Association, which has now been in existence some eight months, and was formed on the advice and with the assistance of the Central Association of Master Builders, with the view of uniting and strengthening the members of the craft, and as a means of defence against what were described as the unwarrantable demands of the trade union officals, who sought not only to boycott individual employers, but to prevent builders from subletting their plaster work. The Association now numbered among its members the majority of the established Master Plasterers of London, all of whom were pledged to conform to the arrangements made between the masters and operatives in June last. Among the objects of the Association was the re-introduction of the system of apprenticeship, with a view of raising the standard of technical and practical knowledge among the operatives. In conclusion, Mr. Wright begged to couple with the toast the name of Mr. E. T. Taylor, a member of the Plasterers' Company, and expressed the hope that they in that Association would always bear in mind the injunction which formed the motto of the Company, and "Let brotherly love continue."

Mr. Taylor briefly replied, and other toasts followed, including "The Secretary," to whom a presentation was made by the President, on behalf of the members, in recognition of his services in connexion with the formation of the Association.

## Correspondence.

*To the Editor of* THE BUILDER.

### THE ORIENTATION OF CHURCHES.

SIR,—Hearty thanks are due to your correspondent, Mr. Francis E. Jones (January 28), for having taken the trouble to calculate the points of sunrise on four varying saints' days. He has thus far rendered a list where none previously existed, and its application cannot fail to produce interesting results.

Mr. J. Houghton Spencer objects to the hypothesis of a shadow from a pole, which I have suggested, on the ground "that different lines on the same day would be given in this way to different localities, although in the same latitude." But is it not these different lines that are actually observable in our ancient churches, and are we not seeking for their cause? But I am not wishing to press a hypothesis—far from it. The subject of orientation is too large for any individual to master it, and it is only by many observers and by conference over ascertained facts that results are to be attained.

Mr. Wm. White's quotation from Durandus indicates the absence of rule with respect to the orientation of a church to the position of sunrise on the saint's day to whom it would be dedicated when completed. It is this belief, vaguely referred to by many writers, that is deserving of most attention; and lists like that which Mr. Jones has begun would soon enable direct evidence to be thrown upon it.

But have we any reference to such a custom in any ancient document? I know of none. And yet, surely if ever practised, there would remain some written record of its use. This is the more likely, since the custom could not have been acted upon without trouble—in some cases a good deal. Founders and builders alike would have had to remain idle, on some occasions for the longest part of a year, waiting for the particular saint's day to come round. Such patient waiting for such a small result as this would surely have had its record in some case had it ever existed.

Your correspondent, F. E. H., will find other examples of churches—and large ones too—as much out of true orientation, or nearly so, as St. Albans Abbey. Of these, one at least, Rievaulx Abbey, owes its axis most probably to the circumscribed site between the river and the base of hills, although the older and much smaller church had the same direction. Rochester Cathedral owes its position to local circumstances, about which some of your readers may hear shortly. Others, however, like Southwell Minster, stand in open ground, and it is subject of enquiry as to the influences that have determined their positions. But it has to be remembered that the axis of a square body, if set out to sunrise at the summer or the winter solstices, will, for many positions in our island, have its angles directed to the cardinal points. These angles will vary in proportion as the times of the solstices are approached or departed from.

E. P. LOFTUS BROCK.

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SIR,—Replying to the question of your correspondent, H. E. T., it may be pointed out that it has not been suggested that a rule for orientation exists to which there are no exceptions.

On the contrary, when it is remembered how early the Christian Church was planted in these islands, that upon the arrival of Augustine considerable differences of opinion and custom were found to exist between that section of the Church which he represented and the British Church, that from the twelfth to the fifteenth centuries alterations were made in our then existing churches by the erection of chantries, and rood-lofts with their accompanying staircases, representing the prevalence of doctrines to which the original builders were probably strangers, then it seems reasonable to suppose that the influence of the Italian party by rededication, or in the case of new buildings by a disregard of orientation, would be the cause of many apparent and actual deviations from the ancient rule. June 17 is the day assigned to St. Alban in the Calendar of the English Church; August 2 is the day connected with the day of his translation, and May 16 with his death; but as each of these days has an orientation north of east, none of them can be connected with the axis of St. Albans Abbey, which your correspondent describes as being "nearly due east-south-east." It should be noticed that in latitude 51° 44' north, the latitude of St. Albans, the true bearing of the sun at rising is much more to the north of east throughout June than 22 or 23 deg., which your correspondent seems to think is its position on some days in that month.

Whether the line of the axis of St. Albans Abbey is that set out by Offa, or was modified in the time of Lanfranc, who, as well as Offa, had relations with the Papal See, it would appear that its connexion by orientation with St. Alban was not regarded by its builders. The poetical idea of ancient church-founders waiting for the rising sun in order to get a guiding line for their work, for which it is believed Wordsworth is responsible, has been more than once alluded to, but this *modus operandi* does not commend itself to the practical builder, taught by experience that waiting for the sun to rise on a particular day may be attended with a very unsatisfactory result. Nor is this to be wondered at when it is remembered that the period of bright sunshine in the British Isles, estimated in percentage of its possible duration, may be as low as 16 in one month, and not give a higher average than 28 for the year. The outline of a table of horizontal angle of sunrise, prepared by Mr. Francis Jones, must prove very useful for comparing the differences between the same days (nominally twenty) in different centuries, brought about by the increasing error of the Julian Calendar, which reached its maximum, as far as our subject is concerned, in 1752.

But it must be borne in mind that the, in some cases considerable, differences in angle which that table shows are the result of an increasing difference between the civil and solar year, and not of an alteration in the actual points of sunrise from one century to another, which difference in Russia, where the old style is still followed, now amounts to twelve days, but which has been corrected in the new style, and is prevented from again accumulating inconveniently by regarding, of the last years of every century only, that of every fourth century as a leap year, thus omitting three days in four centuries, which days would have been added under the old style. The observations of Mr. William White, based upon a remark of a polemic Latin divine, show that there was a difference of opinion with regard to orientation in the fourteenth century, which is precisely what history teaches was the case generally with regard to many ecclesiastical subjects, but do either of the rules alluded to by Durandus necessarily exclude a reference to a particular day? The vernal and autumnal equinoxes and the summer and winter solstices are closely connected with the days of the annunciation of the birth and the birthdays of the Great Founder of Christianity and his forerunner, so that these two ever-prominent personages, by the four days assigned to them at or near these periods, figuratively grasp the whole of the Christian year, and one or the other may be referred to by a solstitial or equinoctial orientation.

Further investigation would show how many churches accord with either of these rules, and if Durandus gives a reason why one rule was right and the other wrong, it would be interesting to have it stated, and if not, it is thought that it would not be difficult to assign one.

The conclusions suggested from a full consideration of the subject generally are briefly these: that a rule for orientation was in operation in the British Church at a very early period, notwithstanding that it was disregarded by a certain party, seeking to influence that Church from without and within; that the early builders could accurately ascertain the true north, if not by the compass, then by means of a circumpolar star, and the true bearing of the sun at rising by calculation in any latitude, and further were aware of the increasing error in the Julian Calendar, and would probably correct it for this purpose; that we have the same means of ascertaining the cardinal points of the compass as they had; that we can ascertain by calculation the true bearing of the sun at rising for any day in the year which, as our calendar is now corrected, would be the same for us as for them with a corrected calendar; therefore we are in a position to test the lines so unalterably laid down—or perhaps rather to recover an idea, an intention, long shrouded it may have been by a subsequent rededication.

J. HOUGHTON SPENCER.

*Taunton*, February 6, 1893.

## The Student's Column.

### CHEMISTRY.—VI.

*Symbol* N. *Nitrogen. Atomic weight* 14.

NITROGEN is an odourless, invisible gas. It forms about four-fifths of the total volume of our atmosphere. Combined with other elements, it is a constituent of most vegetable and animal bodies, and also of many mineral substances. The value of many manures depends chiefly upon the amount of available nitrogenous matter they contain.

Nitrogen is not a poisonous gas, but will not support animal life or combustion.

The most convenient method of obtaining it from the atmosphere is to burn a small dry piece of phosphorus in a bell-jar filled with air, the mouth of the bell-jar being immersed in a tray or dish of water. The burning phosphorus combines with the oxygen of the air in the bell-jar, forming dense white fumes of phosphorus pentoxide ($P_2O_5$), which may at first be seen in the bell-jar, but soon dissolve in the water, leaving the colourless nitrogen in almost a pure state. The water will, of course, rise a little way in the jar, because about one-fifth of the original volume occupied by the air has been removed by the phosphorus.

The following five distinct compounds of nitrogen with oxygen have been identified:—

1. Nitrogen monoxide ..... $N_2O$
2. Nitric oxide ..... $NO$ ($N_2O_2$)
3. Nitrogen trioxide ..... $N_2O_3$
4. Nitrogen tetroxide ..... $N_2O_4$
5. Nitrogen pentoxide ..... $N_2O_5$

The first of these, nitrous oxide or nitrogen monoxide ($N_2O$), forms the "laughing-gas" of the dentist. It may be prepared by heating ammonium nitrate to a temperature not exceeding 250° C. in a test-tube and collecting the gas over hot water (see Fig. 1).

$$NH_4NO_3 = N_2O + 2H_2O$$

(Ammonium nitrate)

The gas is soluble to a considerable extent in cold water. When required for inhalation, laughing-gas must be purified from all acid vapours and from all traces of the higher oxides of nitrogen. This may be performed by passing the gas over lime and then through sulphate of iron solution.

Nitrogen combines with hydrogen to form ammonia ($NH_3$), with hydrogen and oxygen to form nitric acid ($HNO_3$), and with hydrogen and carbon to form prussic acid (HCN).

*The Atmosphere.*

The atmosphere consists almost entirely of a mixture of nitrogen and oxygen gases. They are *not* chemically combined.

Roughly speaking, the gases are mixed in the following percentage proportions :—

| | By Volume. | By Weight. |
|---|---|---|
| Nitrogen | 79·0 | 76·9 |
| Oxygen | 21·0 | 23·1 |
| | 100·0 | 100·0 |

The atmosphere, however, always contains small quantities of other gases. The following may be considered as representing approximately the average composition of air :—

| | By Volume. |
|---|---|
| Nitrogen | 77·95 |
| Oxygen | 20·61 |
| Aqueous vapour (variable) | 1·40 |
| Carbon dioxide | 0·04 |
| Nitric acid, Ammonia, Marsh gas | traces |
| Sulphuretted hydrogen, Sulphurous anhydride (near towns) | traces |
| | 100·00 |

In the open country, and by the sea-shore, traces of ozone are also said to be sometimes found.

*Ventilation.*

All gases expand when heated, and according to the law of the expansion of gases discovered by Charles, for each degree Cent. that any gas is heated above 0° C. it increases $\frac{1}{273}$ part of its volume at 0° C., provided, of course, that the pressure upon the gas remains constant.

Consequently, air, or any gas or mixture of gases, is lighter, bulk for bulk, when warm than when cold, and cold air may, therefore, be regarded as possessing a greater density than warm air. Now, as building stones and bricks are more or less porous to air, it follows from the "law of diffusion" that if air of different densities be placed at opposite sides of these porous materials, the two gaseous mixtures will diffuse into one another, the warmer air diffusing into the colder air more quickly than the cold air diffuses into the warm air. Taking into consideration the great difference which sometimes exists in the winter time between the temperature of the open air and the air of a room which is only separated on one side from the open air by a brick wall, it will be at once recognised that diffusion plays a somewhat important part in ventilation. In fact, it is said to have been shown by experiment that with the temperature of a room of 2,650 cubic ft. capacity at 64° F., and the external air at freezing point, or 32° F., the air in the room became entirely changed in one hour, merely by diffusion *through an ordinary brick and mortar wall.*

According to Prof. V. B. Lewes, even with so small a difference in temperature as 2·5°C. between the external and internal air, air will diffuse through the following materials at the following rates per hour :—

| | Cubic feet per hour. |
|---|---|
| Sandstone | 4·7 |
| Quarried limestone | 6·5 |
| Brick | 7·9 |
| Loose sandstone | 10·1 |
| Mud | 15·4 |

The amount of ventilation produced by diffusion is, however, by no means sufficient to keep the air of a dwelling-room as fresh as it ought to be. It is necessary to adopt other methods of ventilation, which will cause the air of the room to become changed at a much quicker rate. The respiration products when they leave the body are much lighter, bulk for bulk, than the atmosphere, because they are much hotter. Consequently they will rise towards the ceiling of a room, where, if they cannot escape, they will become gradually cooled by contact with the atmosphere. They will then descend and be again respired by the inmates of the room, for respiration products are heavier than air if both are weighed at the same temperature. It is therefore necessary to have an outlet for the waste products near the ceiling, but at the same time it is of little use to provide an outlet for the impure air if no inlet is provided in some other part of the room for *fresh* air.

All methods of ventilation must depend upon setting the air of the room in motion. This, as has just been shown, is brought about by heat, and consequently gas flames, instead of increasing the amount of impure air in a room, may be turned into very efficient ventilators. It is simply necessary to place over each burner a tube with a trumpet-shaped mouth, and to lead the other end of the tube into the open air or into a chimney flue. The hot combustion products rapidly escape through this tube, carrying with them by aspiration a considerable amount of the atmosphere of the room. Here, again, it is very necessary an efficient inlet should be provided from the fresh air. Speaking of ventilation in this way by gas, Dr. Wynter Blyth says that even "a water-closet in the centre of a building may be kept fairly sweet by carrying a tube direct from the outer air in a horizontal position to the floor of the closet, and a shaft led vertically upwards to the roof, and placing in the shaft a tiny jet of gas."

Referring to the air expired by human beings, Professor Huxley ("Lessons in Physiology") says that, "speaking roughly, air which has been breathed once has gained 5 per cent. of carbonic acid, and lost 5 per cent. of oxygen.

"The expired air also contains, in addition, a greater or less quantity of animal matter of a highly decomposable character."

Also that "uneasiness and headache arise when less than 1 per cent. of the oxygen of the air is replaced by other matters."

He also considers that "to be supplied with respiratory air in a fair state of purity, every man ought to have at least 800 cubic feet of space to himself (a room 9 ft. high, wide, and long contains only 729 cubic feet of air), and that space ought to be freely accessible, by direct or indirect channels, to the atmosphere."

It should however be noted that carbonic acid is not an active poison, for so long as the oxygen of the air is maintained in its normal proportion of 21 volumes in 100, it is said that an animal can breathe without much discomfort in an atmosphere containing as much as 10 per cent. of carbonic acid. It would seem therefore that the principal harm caused by small quantities of carbonic acid is that it displaces some of the available oxygen, and that it is only when the proportion of it increases very considerably, as, for instance, in unventilated rooms in which oil or gas is burning, that it is really detrimental to health. It appears that it is to the organic matter which accompanies the $CO_2$ in expired air, that the injurious nature of the air in crowded rooms is chiefly due.

*Vitiation of the Atmosphere by Products of Combustion.*

It has been shown that a true process of combustion is carried on within our bodies, and that the atmosphere is vitiated by the products of that combustion, but it is intended here only to refer to the combustion of coal, gas, oil, and candles. Without the presence of oxygen, coal cannot be burnt, it can only be "carbonised."

When coal is burnt in air, the carbon of the coal unites with the oxygen of the air to form carbon dioxide, or carbonic acid gas as it is often called, while the hydrogen of the coal also unites with the atmospheric oxygen to form water. Now carbon dioxide is beyond all doubt quite unable to support life, even though not an actual poison. Consequently, it is desirable to prevent these products of the combustion of coal from entering and mixing with the air of a room, and it is partially for this purpose that a flue is provided. The most important function of a flue is to carry away the products of the *incomplete* combustion of coal. When oil, gas, or candles are burnt, carbon dioxide and water are formed in just the same manner, and when any of these substances are burnt some means of escape into the outer air ought to be provided for their combustion products. Many theatres have adopted the electric light, which does not vitiate the air, as their means of illumination; but at the same time are provided with ventilating shafts containing small gas-jets within them. This method, although excellent for maintaining the atmosphere of a public place, such as a theatre, church, or assembly hall in good condition, is not suitable for adoption to the majority of private houses on account of expense. It is not sufficient, even in a private house, to adopt the electric light without providing also some efficient means for withdrawing the foul air produced by respiration and allowing an ample inlet for fresh air.

The most economical means of lighting and ventilating a private house efficiently is probably the *ventilating* Regenerative burner. Here we have not only a good, steady light, but at the same time a most efficient modification of the ventilating shaft. Both oil lamps and candles have the advantage of being movable to any part of a room; consequently, less total light is required, for it is seldom desired to illuminate every corner of a room very brightly at one time.

The following table, taken from Professor Lewes's "Air and Water," shows the comparative effects on the air of a room of several methods of lighting :—

*Table showing the amount of oxygen removed from the air, and carbon dioxide and water-vapour generated to give an illumination equal to thirty-two candle-power.*

| Illuminant. | Quantity burnt | Oxygen removed | Products of Combustion. Water vapour | Carbon dioxide | Equal to Adults |
|---|---|---|---|---|---|
| | Grains. | Cub. ft. | Cub. ft. | Cub. ft. | |
| Sperm candles.. | 3,480 | 19·27 | 13·12 | 13·12 | 21·8 |
| Paraffin oil ..... | 1,984 | 12·48 | 7·04 | 8·96 | 14·9 |
| Gas (London) ... | Cub. ft. | | | | |
| Batswing ..... | 11·0 | 13·06 | 14·72 | 5·76 | 9·6 |
| Argand ..... | 9·7 | 11·52 | 12·80 | 5·12 | 8·5 |
| Regenerative.. | 3·2 | 3·68 | 4·16 | 1·60 | 2·6 |

Hence, while 32 candles would vitiate the air with the same amount of carbon dioxide that 21·8 adults would give, the same amount of light may be obtained from a Regenerative burner with the comparatively small amount of carbon dioxide that 2·6 adults would produce. Of course, in practice, this enormous difference would not be obtained, for while it is a common occurrence to have an illumination equal to 32 candles in a room when lighted by gas, no one would think of having 32 standard candles alight at one time in an ordinary room. The difference is, however, sufficiently marked to show that even in practice, illumination by means of the Regenerative burner is not only less likely to be injurious, but is also more economical than by the other means mentioned. It is not always, however, convenient for application to rooms in private houses; and has the disadvantage of being very unsightly.

While upon the subject of combustion products, it may be well to draw attention to the fact that comparatively large gas-stoves are often fitted in private houses without being connected in any way with a flue. This cannot be too strongly condemned. No gas-stove should be allowed in any room of ordinary size unless some means are provided for preventing the combustion products finding their way into the room.

Carbon dioxide is a product of *complete* combustion. Carbon mon-oxide and acetylene are produced by the *incomplete* combustion of coal-gas. Both these gases have been shown to be present in the products of combustion when gas is burnt in ordinary burners. The first of these products, carbon mon-oxide, is exceedingly poisonous, while the second is also believed to have deleterious effects upon the health.

## GENERAL BUILDING NEWS.

NEW POST OFFICE, PAISLEY.—New Post-Office buildings which have been erected in the County-square, Paisley, were opened on Monday. The new premises are situated in the centre of the town, and close to the Glasgow and Paisley Joint-Line Station buildings. In the architecture of the premises the Tudor or Domestic Gothic style has been adopted. The new building is in two stories, and from the ground floor to the ridge of the roof the height is 40 ft. The public office, which is 40 ft. in length by 22 ft., and 15 ft. from floor to ceiling, is on the ground floor of the main building, with the entrances leading off the pavement in the square. The postmaster's private room is in the north-east corner of the main building, behind which there is a retiring room for clerks and sorters. At the rear of the public office is the sorting room. This department is 57 ft. long by 25 ft. wide. The light is supplied from the roof. The batteries and other apparatus belonging to the telegraphic department are to be kept in premises behind the sorting room. The mails will be taken in through an archway at the back of the building, while on the south side a separate entrance has been provided for taking in stores, &c. On the first floor, above the public office, is the telegraph room, 54 ft. by 22 ft. Retiring rooms for telegraph clerks and messengers are also placed on the first floor. The building is heated throughout with steam pipes. The architect of the building is Mr. W. W. Robertson, of H.M. Office of Works, Edinburgh, and the clerk of works was Mr. Thomas Ely. The principal contractor was Mr. Alexander M'Naughtan, joiner, Paisley; and the sub-contractors were—Mason work, Mr. William M'Ghee, Paisley; plumber work, Mr. Kilpatrick, Paisley; plaster work, Messrs. John Fraser & Co.; slater work, Mr. Charles Wallace, Paisley; and heating apparatus, Messrs. Mackenzie & Moncur, Edinburgh.

BOARD SCHOOL, SEACOMBE, CHESHIRE.—On Monday last there was opened at Seacombe the new school, built from the plans of Mr. Mellard Reade, F.R.I.B.A., of Liverpool, for the Seacombe School Board. The buildings consist of separate boys', girls', and infants' schools, grouped under one roof, and all on the ground floor. The site, which has a frontage of 230 ft. to Poulton-road, and 240 ft. to a new road called Park-road, contains about 7,500 square yards. The buildings front Poulton-road, and are set back therefrom 80 ft., giving good playground to the south. The boys' and girls' school-

rooms are 72 ft. by 25 ft. They are lighted by high and spacious windows at the ends, and with lantern light in the centre. The roof spanning the two rooms is carried with wrought-iron backs without tie rods. Opening out of the boys' school-room are two small school-rooms, 42 ft. 6 in. by 22 ft., fitted with sliding screens. Two class-rooms, each 29 ft. 6 in. by 22 ft., and cap-room and lavatory, with teachers' rooms over, complete the boys' school, which will accommodate 390, is arranged on a similar principle, but with class-rooms for sixty each, now being fitted up for teaching cookery, cloak-room, lavatory, and teachers' room. The infants' school, for 368, contains school-room, 52 ft. by 20 ft. (for 168 children), two class-rooms for sixty each, and babies' room for eighty, with cloak-room, infants' lavatory, and teachers' rooms over. The whole of the school and class rooms are arranged so as to obtain left-hand lighting. The building is lighted by low-pressure hot water apparatus, the boiler being placed under the girls' cloak-room. Open fireplaces are also provided in most of the school and class rooms. The whole of the floors are laid with wood-block flooring on concrete, the platforms for desks being pitch pine boarding. The ventilation is effected, in addition to sash windows, by specially-designed casement inlets and Hatton's extractors. Covered playgrounds, drinking fountains, and latrine accommodation is provided in the playground, which is surrounded by a low-coped wall and wrought-iron railing and gates. A large portion of the playground is laid with Atkins's asphalte, the remainder being gravelled. In a detached building in the south-east corner, facing Poulton-road, is the board office, boardroom, and large waiting hall, and attached is the caretaker's house, consisting of six rooms, bathroom, &c. The internal fittings are of pitch pine. The building is erected mainly of grey stock bricks, the dressings of windows, doors, and chimney shafts being of moulded Ruabon terra cotta. The masonry is of red sandstone. The contractors were Messrs. Roberts & Robinson, Limited, of Liverpool, Mr. E. Hatton having executed the ventilating arrangements, and Messrs. Killick & Cochran, Liverpool, the hot water apparatus. The fittings have been put in by the North-Western Educational Company, Liverpool, and Messrs. Heywood, Manchester. The whole work has been carried on under the superintendence of Mr. W. Losh Tiffin, Mr. Reade's assistant, with Mr. S. Harrison as clerk of the works.

PROPOSED NEW INFECTIOUS DISEASES HOSPITALS IN DURHAM.—In view of the spread of small-pox or other specially infectious diseases, the Houghton-le-Spring Union Rural Sanitary Authority have, says the *Newcastle Chronicle*, accepted tenders for the erection of two Infectious Hospitals, one to be situate near the Hetton-le-Hole and Rainton district, and the other near the Herrington, Newbottle, and Penshaw district. Each hospital will accommodate twelve beds in addition to the administration department, which consists of matron's and doctor's rooms, with kitchen, four nurses' bedrooms, bath, &c., according to plans and specifications prepared by Mr. D. Balfour, M. Inst. C.E., of Newcastle-on-Tyne. The foundations are of brickwork in cement, and thoroughly ventilated. The walls are of strong galvanised corrugated iron, backed with thick felt properly lapped, attached to wood framing, leaving a 5 in. cavity, and covered internally with V tongued and grooved boarding, stained and varnished, so as to afford an equable temperature in summer and winter. The roof is similarly composed, and is open up to the ridge, and braced with iron tie rods. The flooring is of tongued and grooved boarding securely nailed to the joists. Ventilation is provided by means of falling top sashes in the windows, with solid side wings to prevent down draughts. In the roof are fixed dormer windows. Gable ventilators are provided at the end of each ward, which are hung so as to allow the whole of the opening to be used as an air space. These arrangements secure an air current from end to end of the wards. Constant ventilation is afforded by a perforated ridge board, overlapped with double iron roof plating externally. Each ward is provided with a pedestal water-closet, bath-room with portable bath, and slop-sink, disconnected from the wards by a passage ventilated crossways at both ends. For the complete isolation of each ward covered corridors, open along each side, are formed between the administration offices and each of the wards. The sites, which each comprise 1½ acres, are altogether enclosed with close creosoted fencing 6 ft. 6 in. high, and all parts of the building are to be 40 ft. at least from boundary, according to the regulations of the Local Government Board. The subsoil of each site is properly drained. The drainage of the hospital is of the best fireclay socket pipes, which discharge into the main sewer. A disconnecting chamber is formed at the boundary entrance gateway, and inspection chambers at all angles, as also two automatic syphon flushing tanks at the summit of the drainage. Baths and sinks are properly disconnected, and water-closet soil pipes are ventilated above the eaves. The water supply is obtained from water mains adjoining, and the whole buildings are supplied with hot and cold water. The heating is by means of slow combustion stoves placed in the centre of the wards and administration offices, and this is largely increased by the hot-water supply pipes. A laundry, disinfecting room, mortuary, ambulance shed, and coal house are provided in the rear of the buildings. Rain-water tanks are formed and connected to laundry and scullery. The tender of Messrs. Humphreys, Limited, London, for the iron and wood work, with all internal fittings, &c., has been accepted, and of Mr. R. Hudson, jun., builder, Sunderland, for the foundations, drainage, and road work, the whole to be fully completed in a month, ready for occupation, if necessary.

ST. MARGARET'S CHURCH, LEYTONSTONE.—The new Church of St. Margaret's, Harrow Green, the foundation stone of which was laid by the Marchioness of Salisbury on March 19 last, has been opened for divine service. The designs were prepared by Messrs. J. T. Newman & Jacques, of Fen-court, E.C., the contract being entrusted to Mr. S. J. Scott, builder, of Walthamstow. The total cost of completing the designs is estimated at 7,000*l.* The new church occupies a site at the corner of Woodhouse and Cobbold-roads. It is in the thirteenth century style, and is constructed of brick. It comprises a nave with lofty barrel roof, and north and south aisles, the roofs of the aisles sloping down from the clearstory windows of the nave. The chancel is shut off from the nave by a dwarf screen, and is approached by a flight of three or four steps. Another flight of steps leads to the altar. The organ chamber is on the north side of the chancel, and the morning chapel, which is not yet completed, is on the south side. The east wall above the altar is draped with hangings until a reredos can be provided. The columns supporting the arches of the nave are of dark red brick with Bath stone dressings. The nave is furnished with plain open benches, and these and the choir stalls were supplied by Messrs. Wake & Dean, of London-road, S.E. The church is well-lighted and ventilated, and is heated with hot air. A carved oak altar-table has been given to the church by the Misses Nutter. This was made from designs by the late Mr. Fowler, of Louth. The carving of the three panels is the work of Herr Sebastian Zwinck, of Oberammergau. They are descriptive of "The Good Shepherd."

## *SANITARY AND ENGINEERING NEWS.*

SEWAGE DISPOSAL WORKS, ECCLES.—On the 3rd inst. Major-General Crozier, R.E., an inspector of the Local Government Board, held an inquiry at the Council Chamber at the Town Hall, Eccles, into the facts relating to an application made by the Eccles Town Council for sanction to borrow 14,000*l.* for works of sewage disposal. Mr. G. Trenbath (Town Clerk *pro tem.*) informed the inspector that the population of the Borough at the last census was 29,600, and was increasing yearly at the rate of at least 1,000. It was proposed to deal with the sewage at Salt Eye, in the township of Barton-on-Irwell. The Corporation were the possessors of an estate of 71 acres there.—Mr. H. L. Hinnell, engineer, of Bolton, described the proposed works on the estate at Salt Eye under the scheme which he has prepared for the Local Board, and which the Corporation has adopted. The land, he said, is generally light and suitable for filtration purposes, being generally sand and gravel. He estimated the total cost at 13,794*l.* This included an item for repairs to the homestead, which the inspector said could not be the subject of a loan, but must come out of the rates. After the inquiry had closed, General Crozier visited the site.

SEWERAGE SCHEME, CLITHEROE (LANCASHIRE).—On the 2nd inst. Major-General Crozier, one of the Inspectors of the Local Government Board, held a public inquiry at Clitheroe with regard to the application of the Corporation for a Provisional Order to purchase land for a sewage farm for the Borough, and to borrow over 20,000*l.* to carry out the scheme.—The Town Clerk pointed out that at present there was no proper system of sewerage in the Borough. The pail system was principally adopted.—Mr. Newton, engineer, explained the proposed scheme, and the Borough Surveyor said that at present most of the sewers were simply stone drains which emptied themselves into the brooks.—The Inspector said that all such drains should be pulled up and proper sanitary pipes put in. This was not provided for in the proposed scheme.

## *FOREIGN AND COLONIAL.*

FRANCE. — The exhibition of the works of Meissonier at Paris will open on March 6, on which day the entrance price will be 100 francs. The products of the exhibition are to go to the Artists' Orphanage and to the Asylum of "l'Hospitalité de Nuit."——The fifteenth exhibition of the French Society of Watercolour Painters was opened last Saturday at the Georges Petit Gallery. The annual exhibition of the "Cercle de l'Union Artistique," known under the name of the "Mirlitons," has also just opened.——MM. Vaudremer, Daumet, and Pascal have been appointed as judges in the competition for the Hôpital Boucicaut.——A committee has been formed to erect a monument to Galland, the decorator. The monument, which is entrusted to MM. Gerôme and Coutan, will be erected in the room in the Musée des Arts Décoratifs which is devoted to the drawings and designs of the late artist.——The Louvre has acquired an ivory plaque dating from the fourth century, representing St. Paul preaching in a public place in Rome. The bas-relief is remarkable for the delicacy and precision of the architectural details.——A large new building is shortly to be opened in the Jardin des Plantes, containing hot-houses, aviaries, a palm-house, and a large concert hall.——The museum at Versailles has acquired some interesting pictures lately; and the public are now admitted to the curious gallery of historical portraits in "Attique du Nord," which has been closed for a long time for repairs.——The "Société Nationale des Architects de France" has opened a competition for the plan of a model lodging house to be situated in the Belleville quarter.——A certain number of the Luxembourg pictures have been distributed among the provincial museums; Baudry's "John the Baptist" has gone to Amiens; Cormon's "Vainqueurs de Salamis" to Rouen; one of Isabey's works to Amboise, &c.——The Ministry of Public Works has under consideration a project for preventing the dangerous floods of the Garonne, and which will include the formation of twelve reservoirs in the upper portions of the valleys traversed by the river.——The jury charged with the competition for the new Prefecture at Troyes have awarded the first premium to M. Brouard, architect, of Troyes; the second to M. Lesueur, of Paris; the third to M. Cordier, of Paris.——A Hôtel de Ville, of monumental proportions, including a Salle des Fêtes, is to be erected at Commentry (Allier).——A deputation of the Municipal Council of Toulon is to visit Eastbourne and Levallois-Perret; the former place in order to study the working of the Shone ejectors; the latter, to see the Berlier apparatus, in order to make application of one or the other system at Toulon.——The death is announced of M. Delettre, secretary-general of the Académie de France, at Rome.

BERLIN.—A church is to be erected in memory of the late Emperor Frederick. The building will cost 25,000*l.*, and will be situated in the Thiergarten, on a site presented by the Emperor. The money is to be raised by voluntary subscription.——The models of the proposed monument to the late Empress Augusta are on view at the Town Hall. Five sculptors have competed for the commission. Each competitor receives 50*l.* to cover his expenses.——The first premium in a competition for the design of a large synagogue for Koenigsberg has fallen to Messrs. Cremer & Wolfenstein, of Berlin. This firm has but lately completed a very fine synagogue in the Lindenstrasse.——For once Berlin has had a serious fire, which had to be swamped, instead of systematically extinguished. The extensive cellarage of the Central Market got alight, and, owing to structural defects as to partitions and approaches, it was nearly gutted. 25,000*l.* is the loss in agricultural produce. The ironwork gave way as usual, and hence there will have to be some expensive reconstruction.——Besides the large sums voted by the Imperial Parliament for public works to be done in Prussia, some thirty-seven million marks are to be voted for similar purposes by the Prussian Diet.

## *MISCELLANEOUS.*

"GOEHRING."—This is the name given to a system of moulding geometrical patterns mechanically on the surface of wood, carved out by Messrs. J. M. Bennett & Sons, timber merchants, of Manchester. It is ingenious, and may recommend itself to speculating builders who want to get an appearance of ornamental finish at a cheap rate. We do not think architects will have anything to say to it.

PROPOSED CANOPIED REREDOS, PETERBOROUGH CATHEDRAL.—At a meeting of the Peterborough Cathedral Restoration Committee on the 2nd inst. the Bishop of Leicester, Vice-Dean, in the chair, an offer of a canopied reredos, designed by Mr. Pearson, R.A., was received through the Dean-Designate from the eight surviving children of the late Dr. Saunders, Dean of Peterborough from 1853 to 1878, as a memorial to their father and mother. The offer was accepted.

THE EAST-END DWELLINGS COMPANY.—We have received the report and balance-sheet of this company for the past year. It is stated that a leasehold site in Mansford-street, Bethnal Green, has been acquired, and buildings which will contain 208 rooms are in course of construction. Midhope Buildings, comprising 245 rooms, besides a workshop, a club-room, and an estate office, are completed; other new buildings have been actively proceeded with, and it is expected that before the end of 1893 the whole of the estate will be covered. As soon as this is the case the directors will take steps for providing a specific leasehold redemption fund. Out of the whole of the new buildings only two small rooms in Midhope Buildings were unlet at the end of the year.

PROPOSED TECHNICAL COLLEGE, DARLINGTON.—The Darlington Town Council, at its quarterly meeting held on the 2nd inst., agreed to purchase of the trustees of the late Mr. J. B. Pease, for 1,500*l.*, a site in Northgate containing 2,082 square yards, for the erection of a technical college. The architect appointed by the Council is Mr. G. G. Hoskins, F.R.I.B.A.

# CONTRACTS AND PUBLIC APPOINTMENTS.

## CONTRACTS.

| Nature of Work or Materials. | By whom Required. | Architect, Surveyor, or Engineer. | Tenders to be delivered. |
|---|---|---|---|
| *Supply of Materials | Willesden Local Board | O. Claude Robson | Feb. 14 |
| Roadmaking, Ossett-lane, Earlsheaton | Soothill Nether L. B. | H. Scott | do. |
| Road Works, &c. | Forfarshire C. C. | D. Ross | do. |
| Excavating, Draining, Forming, &c. | W. Wilson & Son | R. M. McDowall | do. |
| Underground Public Convenience | Stratford Town Coun. | Lewis Angell | do. |
| Thirteen Houses, Tylorstown, Wales | S. Cym Jones | S. Cym Jones | do. |
| Laundry Premises, Neath, Wales | Neath Steam Laundry Co. Lim. | do. | do. |
| Dwelling-house and Shop, Newburch, Aberdeen | A. Imlach, Jun. | A. Corvie | do. |
| Cast-iron Pipes (3,100 yds.) | Tunbridge Wells T. C. | W. Brentnall | do. |
| Widening Bridge, Huddersfield | Linthwaite Local Bd. | Abbey & Hanson | do. |
| Supplying and Laying Cast-iron Pipes, &c | Linlithgow Dist. Com. of County Council | J & A. Leslie & Reid | do. |
| Additions to Workhouse, Lunatic Department | Belfast Union | Young & Mackenzie | do. |
| Supply and Fitting-up of Drying Closets, Fever Hospital | do. | do. | do. |
| Alterations, &c. to Business Premises, Bacup | J. R. Taylor | Smith & Cross | do. |
| Road Metal, Flints, &c. | Watford Local Board | *Official* | do. |
| Supply and Laying Cast-iron Water Mains and Accessories, Stuttgart (3,700 metres) | Grombach Magistracy | do. | do. |
| Temporary Corrugated-iron Hospital Building | Rawtenstall Corp. | do. | Feb. 15 |
| Walls, Roofs, &c. | Oxford Gas Company | do. | do. |
| Purifiers, Elevators, &c. | Middleton Corp. | do. | do. |
| Additions, &c. Workhouse | Burnley Union | ..... | do. |
| Sewering and Draining Works, Smallbridge | Rochdale Corp. | S. S. Platt | do. |
| Two Houses, Offices, &c., Foveran, Aberdeen | ..... | Wilsone & Duffus | do. |
| Alterations and Additions to Business Premises, Rotherham | Masbro' Equitable Pioneers Soc. Lim. | H. L. Tacon | do. |
| Residence, Woolacombe Bay, N. Devon | ..... | W. C. Oliver | do. |
| Girders, Southport Pier | ..... | J. & H. Brunlees | do. |
| Excavating, Forming, Sewering, Paving, Kerbing, &c. (four streets) | Stockport Corp. | J. Atkinson | do. |
| Brick Sewers (Contracts Nos. 3 & 4) | Halifax Corporation | E. R. S. Escott | do. |
| Street Works, Lewis Estate, Cardiff | ..... | Seward & Thomas | do. |
| Widening of Street, Forming, &c. | Crewe Town Council | G. Eaton-Shore | do. |
| Sewering, Forming, Kerbing, Channelling, Paving, &c. (eleven new streets) | do. | do. | do. |
| *Temporary Infirmary | West Ham Union | F. J. Sturdy | do. |
| *Cleaning, &c. S.W. Hospital | Met. Asylums Board | T. W. Aldwinckle | Feb. 16 |
| *Iron Fencing and Entrance Gates | Ealing Local Board | C. Jones | do. |
| Earthenware Pipes (90 in. and 27 in.) | Blackburn Corp. | J. B. McCallum | do. |
| Broken and Unbroken Granite, Setts, Flags, &c. | Congleton Twn Coun. | R. Burslam | do. |
| *3,000 tons of Spalls of Granite, &c. | Borough of Brighton | F. J. C. May | Feb. 17 |
| Quarrying Road Material and Laying-on same | Alnwick Highway Bd. | G. Short | do. |
| Dwelling-house, Carlinghow, Batley | ..... | Spencer & Son | do. |
| *Painting and Repairs, E. Fever Hospital | Met. Asylums Board | A. & C. Harston | Feb. 18 |
| Road Improvement Works | Halifax Corporation | E. R. S. Escott | do. |
| House and Shop, Llangollen | H. Jones | ..... | do. |
| Road Metal, Kerbs, Setts, &c. | West Bromwich Corp. | J. T. Eayres | do. |
| Church, Abbeydale, Sharron | ..... | J. Norton | do. |
| Purifying and Meter Houses at Gasworks | Macclesfield Town C. | T. Newbigging | do. |
| Supply of Cast-iron Water Pipes, Thuringia (9,000 metres) | Oberhof Communalty | *Official* | do. |
| *Drainage Works at Workhouse | Amersham Union | do. | Feb. 20 |
| *Cottage for Infectious Diseases Hospital | Erith Local Board | do. | do. |
| *Iron Buildings | Christchurch Union | do. | do. |
| *Raising River Wall, &c. at Wharf | Vestry of St. Mary Abbotts, Kensington | W. Weaver | do. |
| Road Works, &c. Roxborough-road, Harrow (1,080 ft.) | Hendon Union R.S.A. | R. A. Wilson | do. |
| Brick Tanks, &c. | St. Albans Gas Co. | A. F. Phillips | do. |
| Additions to Steward House, Rothbury, Alnwick | R. Farrage | G. Reavell, Junr. | do. |

## CONTRACTS—*Continued.*

| Nature of Work or Materials. | By whom Required. | Architect, Surveyor, or Engineer. | Tenders to be delivered. |
|---|---|---|---|
| Alterations and Additions to Free Library, Fleetwood | The Committee | T. Whittaker | Feb. 20 |
| *Sewerage Works, &c. | Dorking Local Board | J. Lemon | do. |
| Bricks, Cement, Lime, &c. | Sheffield T.C. | C. F. Wike | Feb. 21 |
| Showyard Fittings, Doncaster | Agricultural Soc. | ..... | do. |
| Cast-iron Pipes, Bricks, &c. | Barrow - in - Furness Corp. | *Official* | do. |
| *Road Materials | Greenwich Bd. of W. | do. | do. |
| *Stone Paving in Carriageways and Footways | Com. of Sewers (City of London) | do. | do. |
| *New Infant School | Aberdare Sch. Bd. | do. | do. |
| Store Reservoir, Avondale (Scotland) | Lanarkshire C.C. | J. & A. Leslie & Reid | Feb. 22 |
| Cast Iron Pipes, Hamilton, N.B. (11,500 tons) | do. | do. | do. |
| Vagrant Wards, Sergeant's House, &c. Huddersfield | ..... | John Kirk & Sons | Feb. 23 |
| Additions and Alterations to Stables, Aberdeen | Northern Co-op. Co. Lim | A. Maver | do. |
| Wrought-iron Fence | Portsmouth U.S.A. | *Official* | do. |
| *Enlargement of School | Dagenham Sch. Bd. | Wigg, Oliver, & Hudson | do. |
| *Making-up Roads, &c. | Walthamstow Loc. Bd. | G. W. Holmes | Feb. 24 |
| Teacher's Residence, Soldierstown, Ireland | Rev. J. W. Sleator | ..... | Feb. 25 |
| Additions and Alterations to St. John's Church, Boxmoor | The Churchwardens | T. Foster Woodman | Feb. 27 |
| *Two Organs | West Ham Council | Lewis Angell | do. |
| *Works and Materials | Mortlake Highway Bd. | H. Richards | do. |
| *Iron Pipe Sewer, Completion of Street | Toxteth Parochial Bd. | J. Price | do. |
| *School Buildings, Plashet | East Ham Sch. Bd. | R. L. Curtis | do. |
| *Public Conveniences, Cart Shed, &c. Ladywell Recreation Ground | LondonCountyCouncil | *Official* | Feb. 28 |
| Gas Holder and Brick Tank | Bruton (Soms.) Gas Co. | do. | Mar. 1 |
| Vaults, &c. Strokestown, Ireland | Roscommon C.A. | ..... | do. |
| Road Metal (12,000 tons) | Hull Corp. | A. E. White | do. |
| *Extending Outfall to Sewer | Christchurch R.S.A. | *Official* | Mar. 7 |
| Water Supply Works, &c. Roumania | Odobesti Municipality | do. | Ad-date |
| Levelling, Paving, Kerbing, &c. | Andenshaw Local Bd. | J. H. Burton | do. |
| Three Cottages, Rawnds, Northants | G. P. Hornsby | ..... | do. |
| Timber-framed Building, St. Helen's, Lancs. | D. Rowell & Co. | ..... | do. |
| Twelve Houses, Tonna, Wales | Aberdulais Build. Soc. | ..... | do. |
| Warehouse, Cottage, Stables, &c. Whitehaven | ..... | J. B. Shepherd | do. |
| Eight Houses (brickwork only), Leeds | A. Ingham | ..... | do. |
| Excavating, Brick, and Stone Work, &c. Abram | Wigan Junc. Colliery | ..... | do. |
| Stables, Sheds, &c. Alfreton | Wessington Hay Farm Co. | Watson & Son | do. |
| Re-building Church, Dowlais | ..... | A. E. Johnson | do. |
| Laying Water Pipes (920 yds.) | Alfreton Local Board | E. Houfton | do. |
| Dwelling-house, Peterborough | J. W. Jackson | J. Ruddle | do. |
| Warehouse, Offices, Shops, &c. (brickwork only) | Wigan Printing Co. | R. T. Johnson | do. |
| Retorts, Condensers, Iron Roof, &c. Kettering | Rothwell Gas Co. | *Official* | do. |
| *Commercial Buildings, Johannesburg | ..... | Peter Dollar | do. |
| *Additions, &c. to School, New Barnet | ..... | F. Child | do. |

## PUBLIC APPOINTMENTS.

| Nature of Appointment. | By whom Advertised. | Salary. | Applications to be in. |
|---|---|---|---|
| *Clerk of Works | Barnet Union | 2*l.* 10s. | Feb. 13 |
| *Borough Surveyor's Assistant | Warrington Corp. | 150*l.* | Feb. 18 |
| *Inspector of Works | Borough of Plymouth | ..... | Feb. 20 |
| *Accountant Clerk | Borough of West Ham | 120*l.* | do. |

*Those marked with an Asterisk (*) are advertised in this number.* *Contracts, pp.* iv., vi., *and* viii. *Public Appointments, p.* xxi.

DISCOVERY OF A SUBMERGED FOREST AT RHYL.—According to the *Liverpool Post*, the action of the tide at Rhyl within the past few days has disclosed the singular sight of the remains of an ancient forest which, for a period of eighty years, has been completely covered by the sea. The scoured portion of the beach where this remarkable sight is presented is situate opposite the Marine Drive, about a mile east of the pier. The Town Surveyor (Mr. R. Hughes) has made a plan of the place, which shows about thirty trees rooted as they grew, whilst there are a number of horizontal trunks which appear to rest where they fell. Several of the trees have been proved to be of oak and elm, and the remainder appeared to be birch, alder, and hazel. The stumps vary in diameter from 12 in. to 24 in., and are situate about 100 yards from the edge of the sandhills, and are covered during the high spring tides by about ten feet of water. The scored portion in the sands, which exposes these old roots, extends for about 550 yards in length, and varies in width from seven to thirty-five yards. Folk lore asserts that this is a part of an old forest, the portion in question being known as "Coed Brawr y Rhyl."

THE ENGLISH IRON TRADE.—Quietness is still the prevailing characteristic of the English iron market, and it is doubtful from what quarter any improvement may be expected. The squeeze in the Glasgow warrant market continues. In nearly all branches of the crude iron trade little activity is noticeable, and in manufactured iron and steel only a hand-to-mouth business is generally reported. Tinplates, however, are in rather better request. Shipbuilders and engineers evince no change. The coal market remains in a dull condition.—*Iron.*

PROPOSED ART AND INDUSTRIAL EXHIBITION AT REDDITCH.—It is proposed to hold an exhibition at the Public Hall and Institute, Redditch, to be opened for three weeks at Easter next. It will comprise pictures and works of art from many of the best collections in Worcestershire and Warwickshire. An additional feature of interest will be the work of the technical schools at Worcestershire. At a meeting of the Technical Education Committee of the Worcestershire County Council, held at Worcester a few days ago, it was decided to recognise the Redditch exhibition officially, and to invite the committees of all technical schools in the county to send specimens of their pupils' work in wood carving, joinery, and ornamental iron work for the present winter session.—*Birmingham Gazette.*

PROPOSED NEW RAILWAY STATION AT CLECKHEATON.—A joint meeting of the Cleckheaton Chamber of Commerce, the Local Board, and the Tradesmen's Association, was held on the 3rd inst. at the Town Hall, Cleckheaton, to consider draft plans prepared by Messrs. Castle & Howorth, architects, Cleckheaton, of an alternative scheme for the site of a railway station and approaches at Cleckheaton for the new line of railway (Heaton Lodge to Leeds, *via* Spen Valley) to be constructed by the London and North-Western Railway Company. The principal approach is from Bradford-road, passing through Foundry House estate, and the station is to be located on a site between Taylor's Wood and Spen Hall. The scheme submitted to the meeting was approved, and Messrs. Castle & Howorth were instructed to prepare plans of the same to be submitted to the railway company.

SANITATION IN INDIA.—The example set by Raipur in improving its water supply will, it is hoped, be followed by other local authorities in these provinces. During the last fifteen years, not to go further back, the death-rate in Raipur has been remarkable. In eleven years, out of the fifteen, it exceeded 30 per thousand of the population. In several years it exceeded 40 per thousand, and in one year it reached the frightful proportion of 58 per thousand. Cholera has been present two years out of three, and claimed its victims from every grade of society, but it is hoped that its virulence may in future be abated by the means that have now been adopted. It is especially gratifying to notice that the munificence of a native potentate furnished the greater proportion of the necessary funds, showing that the imputation of indifference to works of sanitation under which natives labour is not always deserved.—*Indian Engineer.*

THE AMERICAN PRODUCTION OF PIG-IRON.—The production of pig-iron in the United States in 1892, according to statistics published by the American Iron and Steel Association, amounted to 9,157,000 tons, against 8,280,000 tons in 1891, 9,203,000 tons in 1890, 7,605,000 tons in 1889, and 6,490,000 tons in 1888. During the last five years, therefore, the output has steadily increased, if we except the relapse in 1891. Compared with the latter year, the production of 1892 increased by 877,000 tons, or 10½ per cent.; compared with 1890, it decreased by 46,600 tons, or ½ per cent. Since the end of 1891 the half-yearly returns have shown a continuous decline, the figures being 4,387,377 tons for the second half of 1892, 4,769,683 tons for the first half of 1892, and 4,911,763 tons for the second half of 1891. The present indications point towards a further shrinkage. At the same time, it should be observed that the stocks of pig-iron are likewise decreasing. At the close of 1890 there were 608,921 tons of pig-iron in stock, which had declined to 596,333 tons on December 31, 1891, and to 596,116 tons on December 31 last. The number of furnaces in blast at the latter date was 253, against 313 at the close of 1891.

SOCIETY OF ENGINEERS.—The first ordinary meeting of the Society of Engineers for the present year was held on Monday evening, February 6, at the Town Hall, Westminster. Mr. J. W. Wilson, junr., the President for 1892, first occupied the chair, and presented the premiums of books awarded for papers read during his year of office, viz.:—The "President's Premium" to Mr. W. H. Holttum, for his paper on "The use of Steel Needles in driving a Tunnel at King's Cross"; the "Bessemer Premium" to Mr. A. G. Drury, for his paper on "The Shortlands and Nunhead Railway"; a "Society's Premium" to Mr. B. A. Miller, for his paper on "The Cleansing and Ventilation of Pipe Sewers"; and a "Society's Premium" to Mr. S. Sellon for his paper on "Electrical Traction and its Financial Aspect." Mr. Wilson introduced the President for the present year, Mr. William Andrew McIntosh Valon, J.P., to the meeting, and retired from the chair, receiving a hearty and unanimous vote of thanks for his services during the past year. The new President having taken the chair, delivered his inaugural address, which mainly dealt with the principles of engineering science as affecting the health, wealth, and longevity of the human race.

THE LONDON & COUNTY BANKING COMPANY, LIMITED.—As will be seen by the report and balance-sheet of this bank, which appear in our advertising columns, the net profits during the half-year ended December 31 last (including balance brought forward from the previous half-year's account) amounted to 261,000*l.*, out of which the Directors have declared a dividend of 10 per cent. on the half-year, making a total of 20 per cent. for the year 1892.

"THE SAFETY TREAD SYNDICATE, LIMITED."—As will be seen by an advertisement appearing in our issue this week, this company has been formed

for acquiring and working the English patent-rights of Mason's patent safety tread covering for stairs, &c. This "tread," which consists of a combination of chilled steel (or other hard metal) and lead, has been already described and illustrated in our pages.

A HAND WINCH.—Mr. Oscar Witte, of Bodenbach, Bohemia, has designed a hand winch for builders' purposes, which can either be worked by pinion and spur wheel on the barrel in the usual way, or by a separate handle which actuates bevel gearing, which in turn works a worm and wheel. The latter gear is for slow speeds, and is made to drive the barrel by means of a clutch, which, of course, is out of gear when the more direct method of operating is in use. The device seems more suitable for marine purposes than in the construction of buildings.

SALARIES AT ST. HELEN'S.—At a meeting of the Council of the County Borough of St. Helen's, held on Wednesday last, it was decided, by 26 votes to 6, that the salary of the Town Clerk, Mr. Wm. Jno. Jeeves, be raised from 500*l.* to 700*l.* per annum, and also that the salary of Mr. Geo. J. C. Broom, M. Inst. C. E., Borough Engineer, be raised 100*l.* per annum from January 1 last.

## *CAPITAL AND LABOUR.*

EDINBURGH TOWN COUNCIL COMMITTEES AND THE CONTRACT SYSTEM.—The Streets and Buildings Committee of the Edinburgh Town Council, at a meeting on the 3rd inst., had before them the remit from last meeting of the Council as to the declaration proposed to be inserted in the city contracts to secure that "the contractors shall pay the standard recognised rate of wages, or such wages as are generally accepted as fair in the trade." Dean of Guild Miller moved that the Committee should report that it was inexpedient to insert such a condition in the forms of offer. Mr. Mortimer seconded. Mr. Eunson moved that the Committee should report in favour of the insertion of the declaration recommended. Mr. Miller-Dunlop seconded. For the motion there voted 8, while for the amendment 6 voted. The motion was therefore carried. At the meeting of the Treasurer's Committee the same subject came up, and the proposal that the declaration should be inserted in the city contracts was rejected by three votes against two.

## MEETINGS.

FRIDAY, FEBRUARY 10.

*Architectural Association.*—Mr. C. J. Tait on "The Value of Criticism." 7.30 p.m.

*Institution of Civil Engineers (Students' Meeting).*—Mr. H. Calder Löbnitz on "Long Shoot Dredgers—their design and mode of working." 7.30 p.m.

*Sanitary Institute (Lectures for Sanitary Officers).*—Mr. W. C. Tyndale on "House Drainage." 8 p.m.

*Society of Arts (Howard Lectures).*—Professor W. C. Unwin on "The Development and Transmission of Power from Central Stations." V. 8 p.m.

SATURDAY, FEBRUARY 11.

*Architectural Association.*—Visit to the Church of St. Bartholomew the Great, West Smithfield, by permission of Mr. Aston Webb. 3 p.m.

*Sanitary Inspectors' Association.*—Dinner at the "Criterion," Piccadilly. 6 p.m.

MONDAY, FEBRUARY 13.

*Royal Institute of British Architects.*—Colonel Lenox Prendergast on "The Cathedral of Palma, Majorca, with some Notes of Buildings in its Neighbourhood." 8 p.m.

*Royal Academy of Arts.*—Dr. A. S. Murray on "The Sculptures of the Mausoleum." I. 8 p.m.

*Society of Arts (Cantor Lectures).*—Professor J. A. Fleming, M.A., F.R.S., on "The Practical Measurement of Alternating Electric Currents." III. 8 p.m.

*London Institution.*—Mr. Shelford Bidwell, M.A., F.R.S., on "Electricity and Heat." 5 p.m.

*Clerks of Works' Association.*—Annual Dinner, Holborn Restaurant. 6.30 p.m.

TUESDAY, FEBRUARY 14.

*Institution of Civil Engineers.*—Dr. Edward Hopkinson, M.A., on "Electrical Railways." 8 p.m.

*British Museum.*—Miss Emily Penrose on "The Daily Life of the Athenians." III. 2.30 p.m.

*Sanitary Institute (Lectures for Sanitary Officers).*—Professor H. Robinson on "Sewerage and Sewage Disposal." 8 p.m.

*Carlisle Architectural, Engineering, and Surveying Association.*—Mr. A. W. Johnstone on "Building Construction in Earthquake Countries."

WEDNESDAY, FEBRUARY 15.

*British Archæological Association.*—(1) Mr. E. A. Ebblewhite on "The Parish and Church of Bedfont, Middlesex"; (2) Mr. Andrew Oliver on "The Monumental Brasses in Westminster Abbey." 8 p.m.

*Society of Arts.*—Professor F. Clowes on "The Detection and Estimation of small Proportions of Inflammable Gas or Vapour in Air." 8 p.m.

*Builders' Foremen and Clerks of Works' Institution.*—Ordinary Meeting. 8.30 p.m.

THURSDAY, FEBRUARY 16.

*Royal Academy of Arts.*—Dr. A. S. Murray on "The Sculptures of the Mausoleum." II. 8 p.m.

*Society of Antiquaries.*—8.30 p.m.

*Institution of Civil Engineers.*—Students' Visit to the Sewage Purification Works of the Hendon Local Board, at Hendon. 2.45 p.m.

FRIDAY, FEBRUARY 17.

*Sanitary Institute (Lectures for Sanitary Officers).*—Mr. H. H. Collins on "Sanitary Building Construction." 8 p.m.

*Society of Arts (Howard Lectures).*—Professor W. C. Unwin on "The Development and Transmission of Power from Central Stations." VI. 8 p.m.

RECENT PATENTS.—Owing to pressure on our space this week, we are obliged to hold over our usual list of Patents until next week.

## SOME RECENT SALES OF PROPERTY:

### ESTATE EXCHANGE REPORT.

JANUARY 30.—By *W. W. Jenkinson:* Nos. 182, 184, and 186, Dalston-lane, f., r. 135*l.*, area 18,000 ft., 2,500*l.*; 19, Navarino-rd., Hackney, u.t. 61 yrs., g.r. 6*l.* 17s. 6d., 420*l.*; 1, Canterbury-rd., Old Kent-rd., and 5 and 6, Wagner-st., f., r. 41*l.* 19s., 205*l.*; 5, 7, 17, to 23 odd, Canterbury-rd., f., 530*l.*; 33, 35, and 37, Canterbury-rd., f., 290*l.*; "Rose Cottage," Wagner-st., f., 195.—By *Weatherall & Green:* "The Pineapple Nursery," Maida Vale, Edgware-rd., u.t. 96 yrs., g.r. 160*l.*, 1,800*l.*; 6 and 8, Knighton-pk.-rd., Sydenham, f., r. 56*l.*, 700*l.*; f.g.r., of 25*l.* 4s., Stanton Villas, with reversion in 92 yrs., 550*l.*; 19, Alexandra-rd., Finsbury-pk., u.t. 81 yrs., g.r. 10*l.* 10s., r. 45*l.*, 350*l.*; 24, William-ter., u.t. 90 yrs., g.r. 6*l.* 10s., r. 26*l.*, 250*l.*; 32, Whistler-st., f., 350*l.*

JANUARY 31.—By *S. B. Clark & Son:* f. market garden land, 12 acres, Heston, Middlesex, r. 60*l.*, 1,720*l.*—By *Matthews & Matthews:* 28, Essex-rd., Islington, f., r. 55*l.*, 963*l.*—By *Dann & Lucas:* An enclosure of f. land, Belvedere, Kent, 14 a. 2 r. 0 p., 450*l.*—By *W. Stocker:* f.g.r. of 27*l.* 10s., St. Dunstan's-rd., Hammersmith, reversion in 96 yrs., 640*l.*; f.g.r. of 44*l.*, reversion in 96 yrs., 1,065; f.g.r. of 18*l.*, Beryl-rd., ditto in 96 yrs., 410*l.*; f.g.r. of 20*l.*, Biscay-rd., ditto in 96 yrs., 465*l.*—By *Messrs. Spellman* (at Norwich): "Pendleton House," St. Saviour's-lane, Norwich, f., 850*l.*; "Clarence House," Thorpe Hamlet, f., 1,530*l.*; copyhold house, Newmarket-rd., with grounds, 1,310*l.*

FEBRUARY 1.—By *F. Jolly & Co.:* 34, St. Peter-st., Islington, f., r. 40*l.*, 600*l.*—By *Baxter, Payne, & Lepper:* "The Eden Lodge Estate," near Beckenham, containing 11a. 3r. 35p., f., 7,000*l.*; three f. cottages and plot of land, Marden, Kent, 300*l.*—By *H. Griffin:* 1 to 17 (odd), Balfern-st., Battersea, u.t. 84 yrs., g.r. 45*l.*, 1,570*l.*; 42 to 56 (even), Stanmer-st., u.t. 84 yrs., g.r. 40*l.*, 1,475*l.*; 25, Austin-rd., f., r. 28*l.* 12s., 395*l.*; 86 to 94 (even), Usk-rd., Wandsworth, f. 780*l.*; 14, Wayland-rd., Clapham, u.t. 64 yrs., g.r. 4*l.*, r. 31*l.* 4s., 150*l.*—By *Messrs. Spellman* (at Ipswich): 1 to 9, St. Margaret's-st., Ipswich, f., in one lot, 1,410*l.*

FEBRUARY 2.—By *D. J. Chattell:* 1, Prospect-villas, Wood Green, f., r. 30*l.*, 530*l.*; 2, Prospect-villas, f., r. 22*l.*, 285*l.*; F.g.r.'s of 10*l.*, Caxton-rd., with reversion in 73 yrs., 255*l.*; 24 and 26, Shore-rd., Hackney, u.t. 42 yrs., g.r. 8*l.*, 725*l.*—By *Beard & Son:* 151, Portobello-rd., Notting Hill, u.t. 58 yrs., g.r. 8*l.*, r. 50*l.*, 450*l.*; 163 and 169, Portobello-rd., u.t. 58 yrs., g.r. 16*l.*, r. 100*l.*, 885*l.*; 121, Portobello-rd., u.t. 58 yrs., g.r. 8*l.*, r. 46*l.*, 365*l.*; 128, Cornwall-rd., u.t. 67 yrs., g.r. 8*l.*, r. 40*l.*, 300*l.*—By *Worsfold & Hayward* (at Dover): 7, Caroline-pl., Dover, f., r., 11*l.*, 175*l.*; 30 and 36, Albany-pl., u.t. 97 yrs., g.r. 2*l.*, 330*l.*; 2, York-st., f., 250*l.*; 11, Russell-st., f., 250*l.*; 45, 46 and 48, Maison Dieu-rd., u.t. 66 yrs., g.r. 6*l.*, r. 53*l.*, 870*l.*; 105, High-st., Charlton, f., r. 20*l.*, 405*l.*

FEBRUARY 3.—By *Baker & Sons:* 3, 5, and 7, Brathway-rd., Wandsworth, u.t. 90 yrs., g.r. 15*l.*, 240*l.*; 17 to 27 odd; 31 to 45 odd; 2, 4, 6, and 10 to 28 even, Brathway-rd., u.t. 90 yrs., g.r. 135*l.*, 2,025*l.*; 10 to 40 even; 47 to 51 even; and 9, 11, and 13, Cambourn-rd., u.t. 90 yrs., g.r. 115*l.*, 1,725*l.*; four plots of f. land, Merton-rd., 1,095*l.*; two plots of f. land, Cambourn-rd., 87*l.*; f.g.r. of 89*l.* 4s., Beckett-st., Camberwell, reversion in 44 yrs., 1,370*l.*; two plots of f. land, Eveline-rd., Forest Hill, 1,720*l.*; 4 and 8, Eveline-rd., f., r. 78*l.*, 840*l.*

[*Contractions used in these Lists.*—F.g.r. for freehold ground-rent; l.g.r. for leasehold ground rent; i.g.r. for improved ground-rent; g.r. for ground rent; r. for rent; f. for freehold; c. for copyhold; l. for leasehold; e.r. for estimated rental; u.t. for unexpired term; p.a. for per annum; yrs. for years; st. for street; rd. for road; sq. for square; pl. for place; ter. for terrace; cres. for crescent; yd. for yard, &c.]

## PRICES CURRENT OF MATERIALS.

### TIMBER.

| | | |
|---|---|---|
| Greenheart, B.G. | ton | 9/0/0 0/0/0 |
| Teak, E.I. | load | 9/10/0 15/0/0 |
| Sequoia, U.S. | ft. cu. | 2/3 2/6 |
| Ash, Canada | load | 2/10/0 4/0/0 |
| Birch, do. | | 3/5/0 4/10/0 |
| Elm, do. | | 3/10/0 4/15/0 |
| Fir, Dantsic, &c. | | 1/10/0 3/10/0 |
| Oak, do. | | 3/0/0 5/5/0 |
| Canada | | 5/10/0 7/0/0 |
| Pine, Canada red | | 2/10/0 3/10/0 |
| Do. Yellow | | 2/10/0 5/0/0 |
| Lath, D'ntsic, fath | | 5/0/0 6/0/0 |
| St. Petersburg | | 5/0/0 7/0/0 |
| Deals, Finland 2nd & 1st std | 100 | 7/10/0 10/0/0 |
| Do. 4th & 3rd | | 7/10/0 8/0/0 |
| Do. Riga | | 6/10/0 8/0/0 |
| St. Petersburg, 1st yellow | | 10/10/0 14/10/0 |
| Do. 2nd yellow | | 8/10/0 9/10/0 |
| Do. white | | 7/10/0 9/10/0 |
| Swedish | | 7/10/0 16/0/0 |
| White Sea | | 8/10/0 17/0/0 |
| Canada, Pine 1st | | 21/0/0 27/10/0 |
| Do. 2nd | | 15/0/0 17/0/0 |
| Do. do. 3rd &c. | | 7/10/0 10/0/0 |
| Do. Spruce, 1st | | 8/10/0 11/0/0 |
| Do. do. 3rd & 2nd | | 6/10/0 8/0/0 |
| New Brunswick | | 6/10/0 7/10/0 |
| Battens, all kinds | | 3/10/0 15/10/0 |
| Flooring boards, sq., 1 in. prep. 1st | | 0/8/0 0/14/0 |
| Do. 2nd | | 0/7/0 0/10/0 |
| Other qualities | | 0/3/6 0/7/6 |
| Cedar, Cuba | ft. | 3½ 4½ |
| Honduras, &c. | | 3½ 4½ |
| Mahogany, Cuba | | 4½ 6½ |
| St. Domingo, cargo av. | | 4 2/0 |
| Mexican do. do. | | 4 5 |
| Tobasco do. do. | | 4½ 7 |
| Honduras do. | | 5 6½ |
| Box, Turkey | ton | 4/0/0 13/0/0 |
| Rose, Rio | | 10/0/0 20/0/0 |
| Bahia | | 9/0/0 18/0/0 |
| Satin, St. Domingo | ft. | 0/0/6 0/1/3 |
| Porto Rico | | 0/0/7 0/1/6 |

### TIMBER (*continued*).

| | | |
|---|---|---|
| Walnut, Italian | | 0/0/3½ 0/0/7 |

### METALS.

| | | |
|---|---|---|
| Iron—Pig, in Scotland | ton | 2/6/0 0/0/0 |
| Bar, Welsh, in London | | 5/17/6 6/0/0 |
| Do. do. at works in Wales | | 5 7/6 5/10/0 |
| Do. Staffordshire, in London | | 6/0/0 6/10/0 |
| COPPER—British, cake and ingot | | 48/10/0 49/0/0 |
| Best selected | | 50/0/0 50/10/0 |
| Sheets, strong | | 58/0/0 0/0/0 |
| Chili, bars | | 45/8/0 45/16/3 |
| YELLOW METAL | lb | 0/0/5½ 0/0/5¾ |
| LEAD—Pig, Spanish | ton | 9/12/6 9/15/0 |
| English com. brands | | 9/15/0 9/17/6 |
| Sheet, English, 6 lbs. per sq. ft. and upwards | | 11/5/0 0/0/0 |
| Pipe | | 11/15/0 0/0/0 |
| ZINC—English sheet | ton | 21/10/0 0/0/0 |
| Vieille Montagne | | 22/0/0 0/0/0 |
| TIN—Straits | | 92/2/6 92/12/6 |
| Australian | | 92/12/6 93/2/6 |
| English Ingots | | 96/0/0 96/10/0 |
| Banca | | 93/10/0 94/0/0 |
| Billiton | | 93/5/0 93/10/0 |

### OILS.

| | | |
|---|---|---|
| Linseed | ton | 20/0/0 20/3/6 |
| Cocoanut, Cochin | | 29/0/0 0/0/0 |
| Do. Ceylon | | 27/5/0 27/10/0 |
| Palm, Lagos | | 29/0/0 0/0/0 |
| Rapeseed, English pale | | 25/10/0 26/0/0 |
| Do. brown | | 24/10/0 0/0/0 |
| Cottonseed ref. | | 23/10/0 0/0/0 |
| Oleine | | 20/10/0 21/0/0 |
| Lubricating, U.S. | | 4/0/0 5/0/0 |
| Do. refined | | 5/10/0 12/0/0 |
| TAR—Stockholm | barrel | 0/17/6 0/18/6 |
| Archangel | | 0/12/6 0/0/0 |

## TENDERS.

[Communications for insertion under this heading should be addressed to "The Editor," and must reach us *not later than 12 noon on Thursdays.*]

BOWES-PARK.—Accepted for alterations and redecorating of Camden Lodge for Mr. T. H. Merrett, Canonbury:—
B. Blissenden ..... £200 0 0

BRIGHTON.—For additions and alterations to 20, West-street, for the directors of the London and South Western Bank. Messrs. Truefitt & Watson, architects, 5, Bloomsbury-square, London:—

| | | | |
|---|---|---|---|
| Cheesman | £1,180 | Patching & Son | £1,019 |
| J. Smith & Son | 1,172 | Lynn & Sons | 998 |
| Chappell | 1,078 | Field, Brighton* | 923 |
| Freeman | 1,040 | * Accepted. | |

BYFLEET (Surrey).—For new sanitary arrangements at Byfleet Hall, for the Church of England Central Society for providing Homes for Waifs and Strays. Mr. A. W. Tribe, architect, 91, Clapham-road:—
Peacock Bros. ..... £260 0 0
J. Galpin, Blackfriars (accepted). ..... 252 10 0

CASTLETOWN (Ireland).—For the construction of water supply works, Castletownbere, for the Board of Guardians. Mr. Richard Evans, engineer, 46, South Mall, Cork:—

| | | | |
|---|---|---|---|
| James Donoghue | £1,470 3 0 | Smith, Bandon* | £1,278 2 6 |
| E. Finn | 1,370 15 9 | * Accepted. | |

EAST HAM (Essex).—For the formation of three new roads and sewers on the Plashet Hall Estate, East Ham, Essex. Messrs. Philip D. Tuckett & Co., surveyors:—

| | | | |
|---|---|---|---|
| R. Ballard | £4,187 | C. W. Killingback & Co. | £3,900 |
| S. Kavanagh | 4,060 | John Jackson | 3,875 |
| E. Rogers & Co. | 3,992 | Eli Wilson | 3,800 |

EBBW VALE (Mon.).—For the erection of a hotel, stables, &c., at Cwm, for the Caerphilly Brewery Company, Limited. Mr. Charles Taylor, architect, 22, Duke-street, Cardiff. Quantities by architect:—

| | | | |
|---|---|---|---|
| Davies & Morgan | £5,451 | D. C. Jones & Co. | £4,244 |
| Bowers & Co. | 4,382 | Hatherly & Carr | 4,197 |
| David Davies | 4,380 | H. Welsh | 4,100 |
| Wm. Gradwell | 4,300 | Thomas Evans | 3,985 |

GODALMING.—For main outfall sewer and sewage disposal works:—

| | | | |
|---|---|---|---|
| W. J. Botterill | £20,215 0 | W. Cuniffe, Kingston-on-Thames* | £13,747 11 |
| J. Neave | 15,481 0 | P. Peters | 12,100 0 |
| S. Kavanagh | 14,853 11 | Morgan, Isted, & Morgan | 10,486 0 |
| R. R. Facey | 14,056 0 | * Accepted. | |
| B. Cooke & Co. | 13,910 0 | | |

HEATHFIELD (Sussex).—For building an hotel at Heathfield, Sussex, for Mr. Francis Verrall. Mr. Alfred A. Oakden, architect, Eastbourne. Quantities by Mr. Robey Carpenter, Burton-on-Trent:—

| | | | |
|---|---|---|---|
| G. Gravett | £4,597 | J. Floyd | £3,935 |
| L. Huggett, 4, St. Leonard's-place, Eastbourne* | 4,460 | Cornwell & Son | 3,750 |
| M. Martin | 4,330 | J. Peerless | 3,690 |
| W. Backhurst | 3,954 | C. Peerless Dennis | 3,550 |
| C. Errey | | * Accepted. | 3,407 |

HUNGERFORD.—For rebuilding the foundry and portion of workshops (exclusive of constructional ironwork in roof, floors, &c.) destroyed by fire, at the Eddington Ironworks, Hungerford, for Messrs. Cottrell & Co. No quantities. Mr. James H. Money, architect:—

| | | | |
|---|---|---|---|
| J. Wooldridge & Son | £856 | G. Elms, Marsh Benham* | £791 |
| H. Hoskings | 792 | * Accepted. | |

LLANDAFF.—For erecting a master's house and cottage, Cathedral School, Llandaff. Messrs. Halliday & Anderson, architects, Cardiff:—

| | | | |
|---|---|---|---|
| Hatherly & Carr | £1,377 0 0 | Richards | £1,198 13 1 |
| Stephens, Bastow & Co. | 1,349 0 0 | Davies | 1,197 0 0 |
| J. Dunn | 1,271 10 4 | Munro | 1,140 0 0 |
| | | Rodger | 1,120 0 0 |

LONDON.—For paving works at Fulham, for the Vestry. Mr. W. Sykes, New Streets Surveyor:—

*Laundry-road.*

| | Roadway. | York. | Adamant. | Victoria. | Stuart's. | Imperial. |
|---|---|---|---|---|---|---|
| | £ s. | £ s. d. | £ s. d. | £ s. d. | £ | £ s. d. |
| Parry, Fulham | 590 0 | 315 0 0 | — | — | — | — |
| Mowlem & Co., Westminster | 617 0 | 299 0 0 | 269 0 0 | 284 0 0 | 269 | 255 0 0 |
| Fry & Fry, Greenwich | 692 0 | 292 10 0 | 195 0 0 | — | — | 217 10 0 |
| G. Wimpey, Hammersmith | 615 0 | 298 0 0 | 216 0 0 | — | — | — |
| E. Rogers & Co., Notting Hill | 572 0 | 296 0 0 | — | — | — | — |
| S. Hudson, Dulwich | 568 0 | 317 0 0 | — | 250 0 0 | — | — |
| Nowell & Robson, Kensington | 607 0 | 357 0 0 | 252 0 0 | — | — | — |
| J. Mears, Kensington | 610 0 | — | — | — | — | — |
| H. J. Greenham, Hammersmith | 680 0 | — | — | — | — | — |
| Imperial Stone Co. | — | — | — | — | — | 225 0 0 |

*Palliser-road.*

| | | | | | | |
|---|---|---|---|---|---|---|
| Parry, Fulham | 670 0 | 265 0 0 | — | — | — | — |
| Mowlem & Co., Westminster | 679 0 | 253 0 0 | 229 0 0 | 241 0 0 | 229 | 217 0 0 |
| Fry & Fry, Greenwich | 708 0 | 250 2 6 | 177 7 6 | — | — | 188 17 6 |
| G. Wimpey, Hammersmith | 565 0 | 250 0 0 | 185 0 0 | — | — | — |
| E. Rogers & Co., Notting Hill | 659 0 | 254 0 0 | — | — | — | — |
| S. Hudson, Dulwich | 644 0 | 268 7 0 | — | 213 4 6 | — | — |
| Nowell & Robson, Kensington | 617 0 | 284 0 0 | 209 0 0 | — | — | — |
| J. Mears, Kensington | 615 0 | — | — | — | — | — |
| H. J. Greenham, Hammersmith | 615 0 | — | — | — | — | — |
| Imperial Stone Co. | — | — | — | — | — | 195 0 0 |

*Dalebury-road.*

| | | | | | | |
|---|---|---|---|---|---|---|
| Parry, Fulham | 265 0 | 147 10 0 | — | — | — | — |
| Mowlem & Co., Westminster | 259 0 | 138 0 0 | 124 0 0 | 131 0 0 | 124 | 117 0 0 |
| Fry & Fry, Greenwich | 282 0 | 132 12 0 | 88 8 0 | — | — | 98 12 |
| G. Whimpey, Hammersmith | 236 0 | 134 0 0 | 98 0 0 | — | — | — |
| E. Rogers & Co., Notting-hill | 256 0 | 133 0 0 | — | — | — | — |
| Nowell & Robson, Kensington | 247 0 | 136 0 0 | 96 0 0 | — | — | — |
| J. Mears, Kensington | 270 0 | — | — | — | — | — |
| H. J. Greenham, Hammersmith | 325 0 | — | — | — | — | — |
| Imperial Stone Co. | — | — | — | — | — | 103 0 |

LONDON.—For the erection of premises, Devon's-road, Bow, E., for Messrs. W. & H. James. Mr. Albert E. Pridmore, architect, 2, Broad-street Buildings, E.C. Quantities by Mr. R. J. Stamp:—

| | | | |
|---|---|---|---|
| Taylor & Son | £947 | C. J. Sherwood | £721 |
| Godson & Sons | 867 | Coulsell Bros. | 693 |
| W. J. Walker | 834 | W. Collins | 675 |
| W. J. Davenport | 787 | H. King | 610 |
| Heatley & Annan | 775 | Wiltshire | 585 |

LONDON.—For erecting Baptist Chapel, Archway-road, N. Mr. J. Wallis Chapman, architect, 11, Sutherland-avenue, W. :—

| | | | |
|---|---|---|---|
| Higgs & Hill | £6,280 | Macmillan & Houghton | £5,095 |
| Shillitoe | 6,191 | King | 4,978 |
| Grover | 5,570 | Woodward | 4,890 |
| Robertson | 5,532 | Chessum | 4,740 |
| Lawrence | 5,460 | E. Houghton & Son, Stroud Green | 4,645 |
| Dove | 5,275 | | |
| Scott | 5,270 | | |

LONDON.—For erecting new warehouse, Grovedale-road, Holloway, for Mr. Mullens. Mr. Wakeford, architect, 15, Stockwell-road, Clapham-road, S.W. :—

| | | | |
|---|---|---|---|
| Thompson | £1,065 | E. Houghton & Son | £884 |
| Rice & Son | 987 | Lown & Son | 790 |
| Lathey, Bros. | 960 | | |

LONDON.—For repairs, &c., to 17, Eastbourne-terrace, W.—Mr. H. A. Rawlins, architect, 46, Queen Victoria-street, E.C. :—

| | | | |
|---|---|---|---|
| Titmas & Son | £286 | Dearing & Son | £231 |
| E. Houghton & Son | 260 | McCormick & Son | 225 |

LONDON.—Accepted for alterations to nine houses, Chicksand-street and Spelman-street, Whitechapel. Mr. C. A. Legg, architect, 13, Grafton-street, Mile End :—

J. Howlett & Son, Limehouse ..... £600

LONDON.—For the erection of a Fire Brigade Station in Cherry-Garden-street, Rotherhithe, for the London County Council. Mr. Thomas Blashill, Architect :—

| | | | |
|---|---|---|---|
| Martin, Wells & Co. | £6,949 | H. Holloway | £6,243 |
| Balaam Bros. | 6,650 | J. O. Richardson | 6,037 |
| Bullars | 6,437 | Whitehead & Co. | 5,990 |
| J. Allen & Son | 6,281 | | |

LONDON.—For repaving, &c., Hammersmith Bridge, for the London County Council. Mr. A. R. Binnie, Engineer :—

Wimpey ..... £2,683 18 4 | Mowlem & Co. .... £2,203 0 0

LONDON.—For erecting three houses and shops in Rye-lane, Peckham, for Mr. H. Holdrew. Mr. A. Stuart, architect, 61, West Smithfield, E.C. :—

| | | | |
|---|---|---|---|
| Gould & Brand | £2,087 | G. Parker | £1,975 |
| Jarvis & Sons | 1,994 | W. Smith (Camberwell)* | 1,898 |
| | *Accepted. | | |

LONDON.—For alterations and repairs to the "Angel and Crown" public-house, Green-street, Bethnal Green, E., for Mr. George Poolman. Mr. Joseph G. Needham, architect, 11, Powerscroft-road, Clapton, N.E. :—

| | | | |
|---|---|---|---|
| E. Walker | £761 | J. & F. Banes | £659 |
| J. Wells | 753 | Worden & Easton, Hackney* | 637 |
| R. Cooper | 730 | *Accepted. | |
| Coulsell Bros. | 663 | | |

[Surveyor's estimate, £640.]

*Gas Fittings.*

| | | | |
|---|---|---|---|
| W. Winn | £92 0 0 | J. Steadman (accepted) | £76 18 6 |
| M. Christian | 77 0 0 | G. Dix | 74 10 0 |

*Pewterers' Work.*

| | | | |
|---|---|---|---|
| S. Williamson | £70 0 0 | S. Warren | £56 0 0 |
| W. Paddon, Junior | 69 0 0 | | |

MILLOM (Cumberland).—For erecting new police station at Millom, for the Cumberland County Council. Mr. Geo. Dale Oliver, County Architect. Quantities by the architect :—

| | | | |
|---|---|---|---|
| L. Ferguson | £3,370 0 | R. Cousins | £2,992 0 |
| Wm. Gradwell | 3,100 0 | W. Tomlinson | 2,989 0 |
| Gray, Mason, & Co. | 3,065 0 | W. Richardson | 2,985 0 |
| H. K. Richardson | 2,998 0 | Wm. Bradley, Millom* | 2,904 7 |
| | *Accepted. | | |

PENYGRAIG (Wales).—For additions, alterations, &c., to school buildings, and erection of an infants' school, Williamstown, for the Llantrisant School Board. Mr. J. J. Evans, C.E., Architect to the Board, Penarth ;—

| | | | |
|---|---|---|---|
| M. Julian | £2,987 | Chedzey & Thomas | £2,830 |
| Rees & Coles | 2,975 | Henry Rowling, Penygraig* | 2,698 |
| Thomas Morgan | 2,898 | *Accepted. | |
| Samuel Evans | 2,854 | | |

[Architect's estimate, £2,822.]

STOCKTON-ON-TEES.—For the supply and fixing of wrought-iron railings at Cemetery, for the Corporation. Mr. R. F. Campbell, Borough Engineer, Stockton-on-Tees. Quantities by the Borough Engineer :—

| | | | |
|---|---|---|---|
| Baker Bros. | £1,322 13 3 | Reay & Robson | £934 11 0 |
| Main Co. | 950 10 9 | Blakeborough & Rhodes | 922 5 2 |
| Hill & Smith | 945 2 6 | | |

[Borough Engineer's estimate, £975 13 9]

SWANSEA.—For the erection of new premises, and additions to the Grand Hotel, Swansea, for Mr. A. Freedman. Mr. T. P. Martin, architect, Swansea. Quantities by the architect :—

| | | | |
|---|---|---|---|
| J. D. Williams | £1,695 | T. Richards | £1,473 |
| Bennett Bros. | 1,620 | Jenkins, David | 1,400 |
| Henry Billings | 1,545 | Gustavus Bros. (accepted) | 1,300 |
| Thomas & Watkins | 1,475 | P. Jones & Son | 1,185 |

[All of Swansea.]

TOTTENHAM.—For the erection of Bruce-grove Schools, for the School Board for Tottenham. Mr. G. E. T. Laurence, architect, 181, Queen Victoria-street. Quantities by Messrs. D. Campbell & Son, 69, Finsbury-pavement, E.C. :—

| | | | |
|---|---|---|---|
| Yerbury & Co. | £20,000 | R. & E. Evans | £15,899 |
| Reed, Blight & Co. | 19,259 | Fairhead & Son | 15,847 |
| Coldswell & Son | 18,124 | C. Wall | 15,700 |
| Lorden & Son | 16,666 | J. O. Richardson | 15,479 |
| A. Kellett | 16,377 | D'Oyley & Co. | 14,947 |
| J. Allen & Son | 15,925 | | |

WIMBLEDON.—Accepted for new stabling at "Fairholme," Worple-road, for Mr. W. B. Faulkner. Mr. A. W. Tribe, architect, 91, Clapham-road :—

G. Davenport, Cambe well ..... £285 0 0

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| | | | | | |
|---|---|---|---|---|---|
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| | | 25. St. David's | *Dec.* | | |

**1893.**

| | | | | | |
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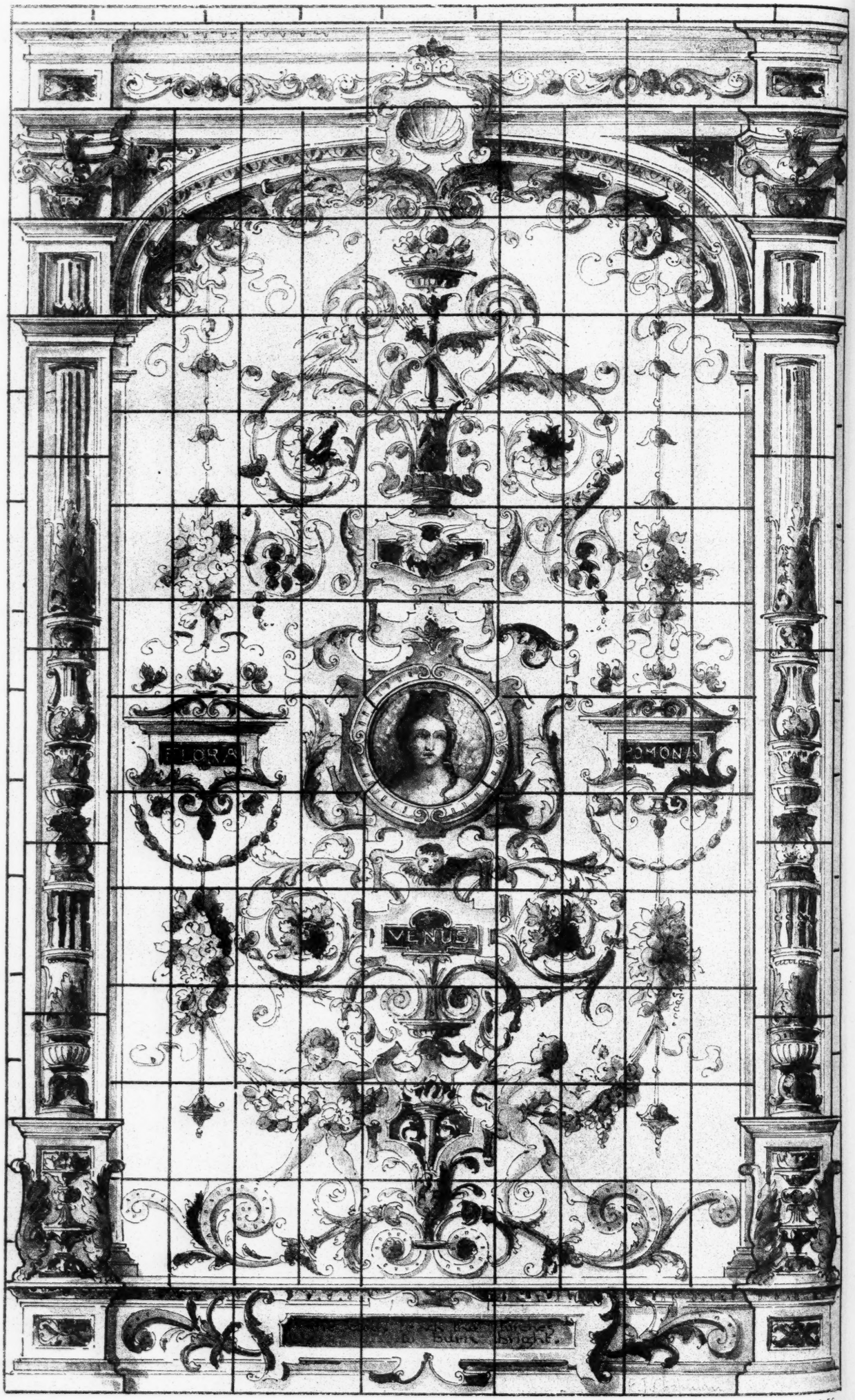


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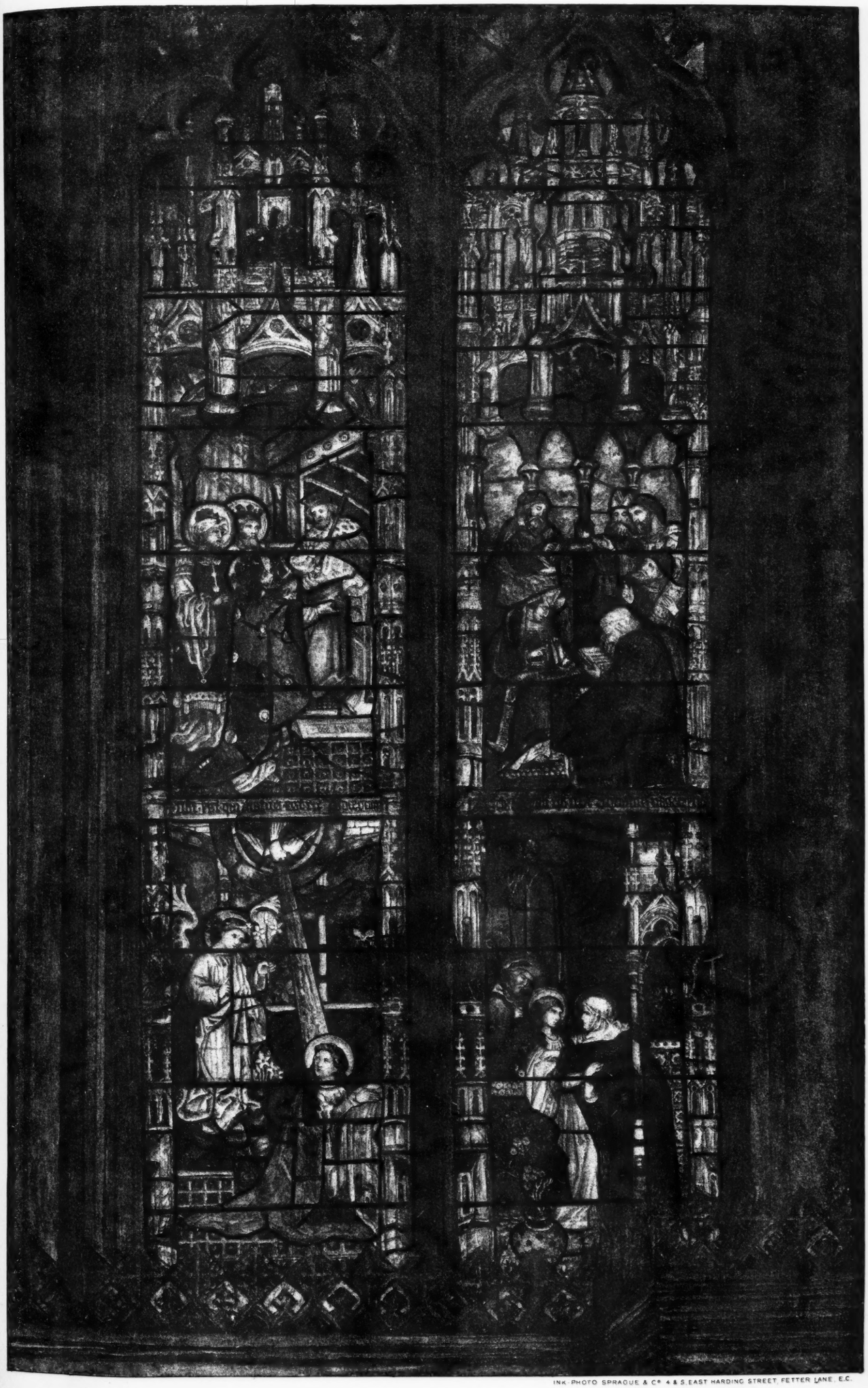
*Royal Academy Exhibition, 1892*



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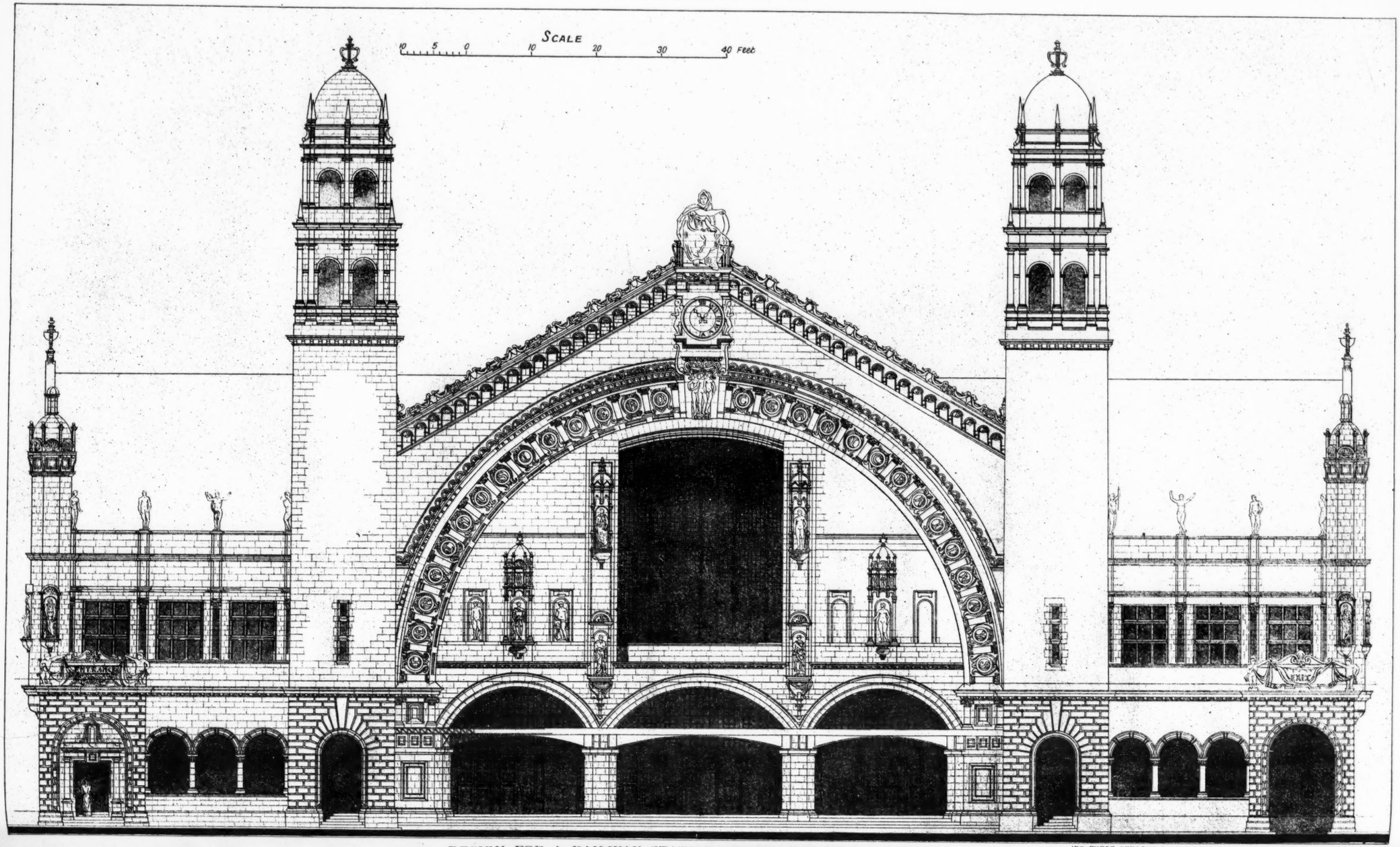
*Royal Academy Exhibition, 1892.*




*Soane Medallion, R.I.B.A., 1893.*

DESIGN FOR A RAILWAY STATION.—By Mr. A. T. Bolton, A.R.I.B.A.
FRONT ELEVATION.

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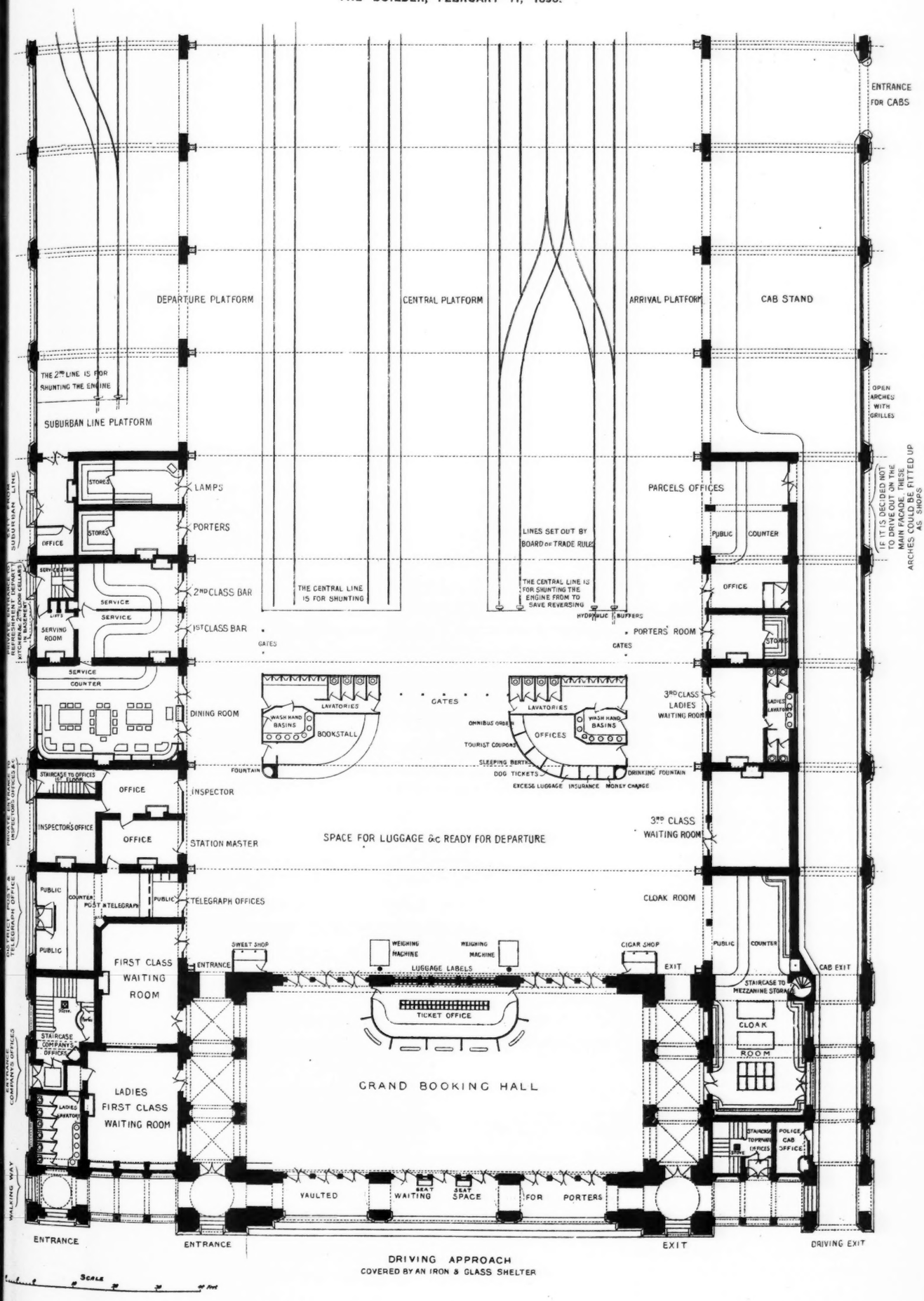


DESIGN FOR A RAILWAY STATION.—By Mr. A. T. Bolton, A.R.I.B.A.
GROUND PLAN.

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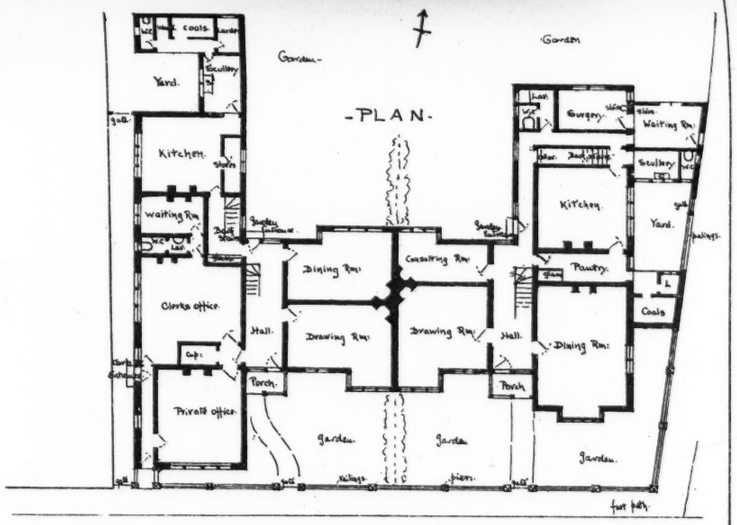


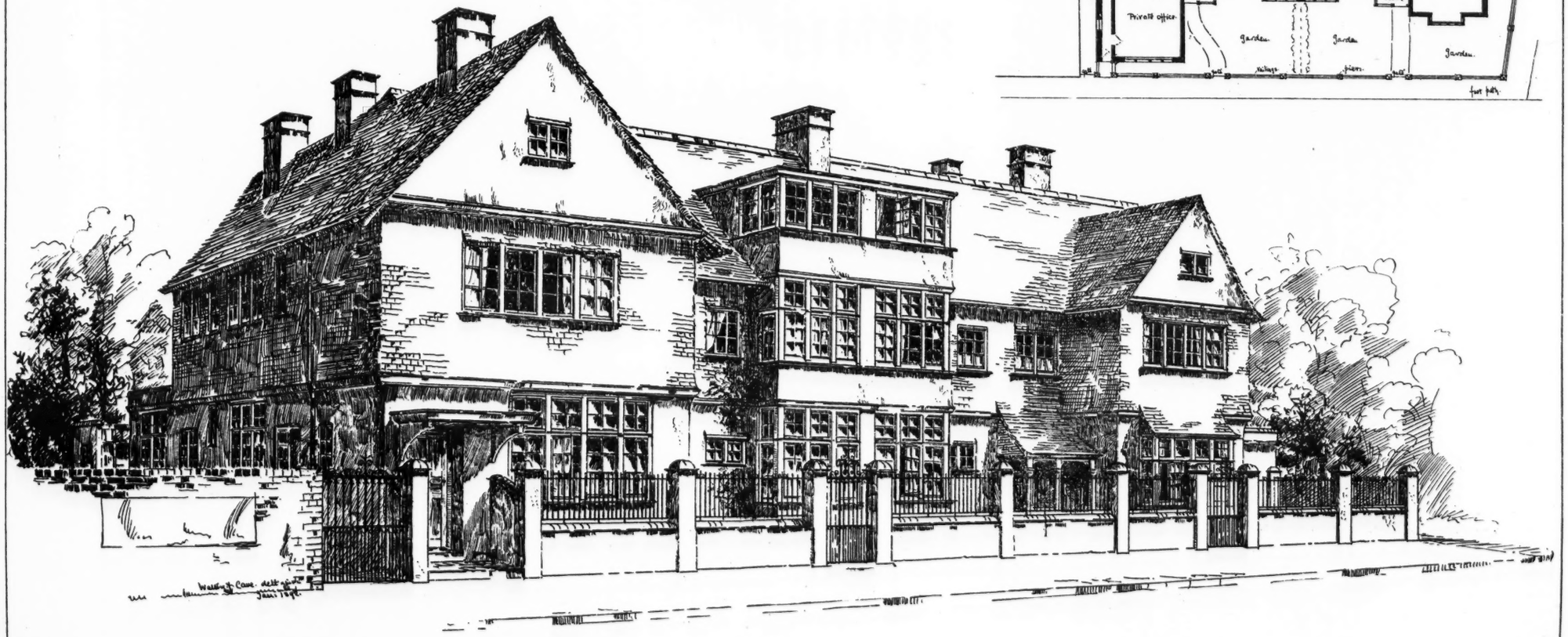

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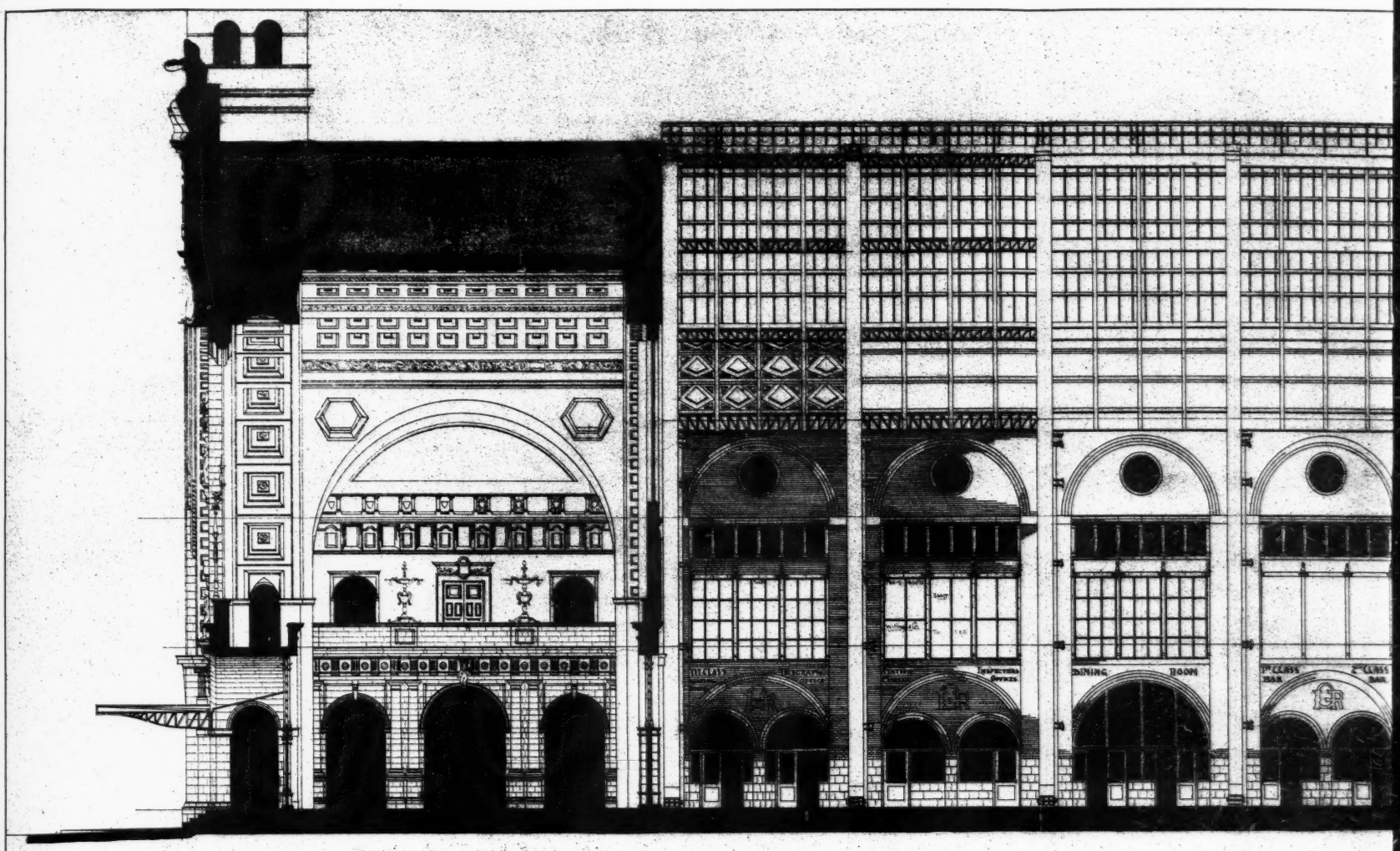


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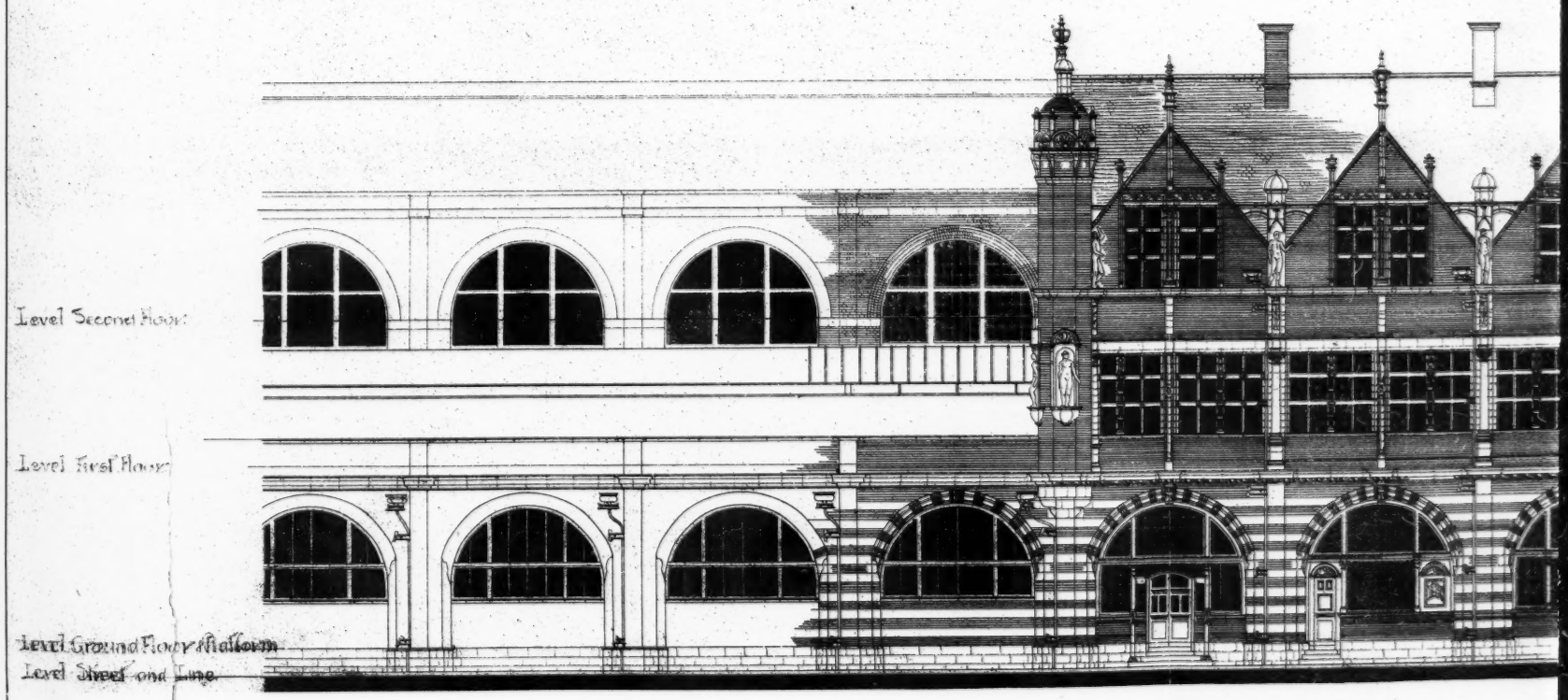
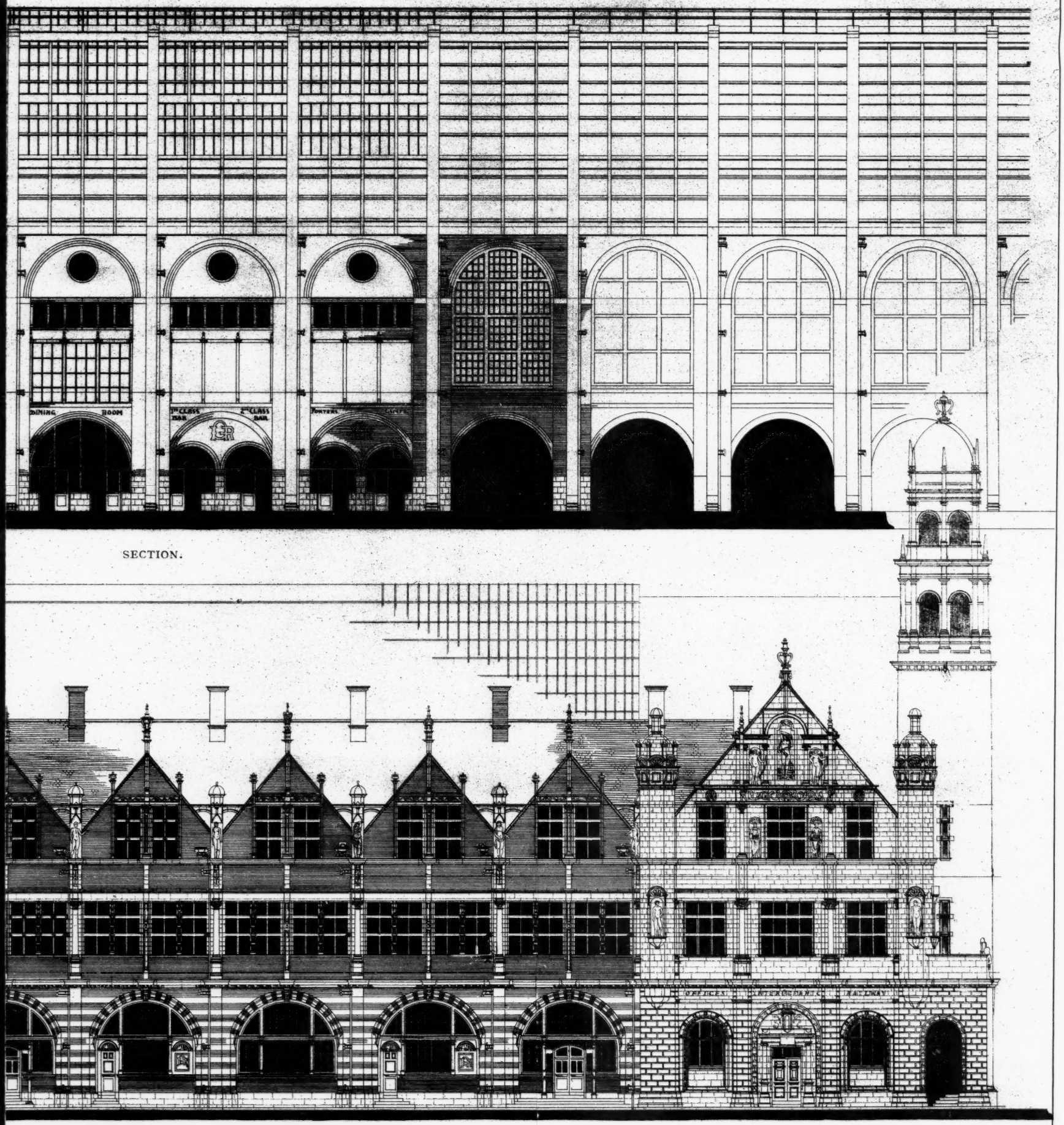



SIDE ELEVATION.

DESIGN FOR A RAILWAY STATION.—By Mr.

*Soane Medallion, R.I.B.A., 1893.*




SECTION.

SIDE ELEVATION.

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OR A RAILWAY STATION.—By Mr. A. T. Bolton.